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SEVENTH SUMMER MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

THE seventh summer meeting of the Geological Society of America convened in Springfield, Mass., August 27th and 28th, 1895. The Council assembled the evening before, prepared the program of the meeting and formulated such other business as was necessary to present to the Society the following day. The fellows and and their friends to the number of thirty-five assembled in the new City Art Museum at 10 A. M., August 27th. The meeting was called to order by President Shaler, who introduced Dr. William Rice, Secretary of the Library Association of Springfield. Dr. Rice welcomed the Society in a few happily chosen remarks, from which the Society learned that they were the first organization to occupy the building. President Shaler replied to the address. Brief memorial mention was made of Professor Henry B. Nason, of Troy, and Professor James D. Dana, of New Haven, the two fellows who had passed away since the last meeting. Extended memorials were, however, postponed to the winter meeting, according to the usual custom. The Secretary announced the election of the following fellows: S. P. Baldwin, Cleveland; O. C. Farrington, Chicago; G. P. Grimsley, Topeka, Kansas; F. P. Gulliver, Norwich, Connecticut; J. B. Hatcher, Princeton, New Jersey; E. B. Matthews, Baltimore; J. C. Merriam, Berkeley, California; H. B. C. Nitze, Baltimore; F. L. Ransome, Berkeley, California; Charles Schuchert, Washington, D. C.; J. A. Taff, Washington, D. C. The report of the committee on the preparation of a card catalogue of scientific literature, which was printed in the

proceedings of the Baltimore meeting, but which had been laid on the table pending amendment, was recalled and passed unanimously. The committee (Emmons and Willis), appointed at the Madison meeting, 1893, to urge on the United States Senate the importance of making the region about Mt. Rainier a public park, reported that they and others had presented the case to the Senate Committee having it in charge, but that the bill had failed of recommendation. On motion the committee was continued, and President Shaler was added to it. Before proceeding to the reading of papers the usual rule was adopted, that papers not presented by their authors in person should go to the end of the list. The first paper read was 'The Champlain Glacial Epoch,' by C. H. Hitchcock, Hanover, N. H. The author stated that when he gave the name Champlain to the clays and sands along this lake, he was a disciple of Lyell, and believed in submergence and iceberg action, but wider experience had made him a follower of Agassiz, and in that he now favored a moderate submergence with local glaciers coming down from the mountains to the east and west, but with an oceanic connection, certainly out through the Gulf of St. Lawrence and probably to the Hudson and westward. He mentioned the species of shells found in the clays of the St. Lawrence Valley, and along the Atlantic near Portland, Maine, and proved them to be of a Labradorian facies. On citing the European divisions of the Glacial Age of James Geikie, the speaker surmised that the Champlain epoch corresponded to the Mecklenbergian.

The paper led to a somewhat extended discussion. I. C. White raised the question of the connection between the submergence and the terraces of the river valleys in the Alleghenies in West Virginia and Pennsylvania, and the lack of fossils. J. F. Kemp cited the barrenness of the clays in the Hudson Valley in all organic remains except a few diatoms, and that the variety was small in the Champlain valley itself. J. W. Spencer remarked the moderate elevation of the Laurentide Mountains so-called and other topographical features of the St. Lawrence Valley. W. M. Davis brought up the importance of properly distinguishing terraces in work of this kind, especially as between marine and re-cut river deposits in valleys. The discussion then drifted to the meaning of Champlain, as to whether it applied to a time division or a series of sediments, and was closed by the president, who suggested that the lack of fossils might be caused by the decay of organic matter in the clays, which would develop gases and destroy them.

The second paper was by H. L. Fairchild, of Rochester, N. Y., and was entitled 'The Glacial Genesee Lakes.' By means of an admirable map, the valley of the Genesee River was shown and the relations of its drainage basin to surrounding river systems. The heights of the divides were marked from the headwaters in Pennsylvania down to Rochester. The argument was then made that the ice-sheet came from the north and filled the valley, all of whose streams were pre-glacial and had flowed in almost all cases near their present channels. Then as the ice retreated the waters at its front and from neighboring heights were ponded back and were drained off to the south, west and east, sometimes to the Allegheny River system, sometimes to the Susquehanna. The old channels are now largely represented by cols with swamps at the divides. Ten stages were recognized in all, viz.: 1. The headwater cols over 2,000 ft. A. T. south of Genesee, Pa. 2. The col at the head of the west branch near Genesee, Pa. 3. At Mapes, N. Y., col, 1606 A. T. 4. Head of Olean Creek, col 1490. 5. The cut from Portage to the headwaters of the Susquehanna. 6. Col at Hor-

nellsville, 1200 A. T. 7. A broad stream to westward over flat country north of Portage. 8. Warren Water. 9. Lake Iroquois. 10. Present relations. The speaker also described the terraces, bisected deltas and other surface deposits that corresponded to the several cols, and remarked that there were but four places where the present streams were working on rock.

I. C. White asked if the old burned channels around these rock cuts were known, but the speaker replied that there was too much drift and too few borings. President Shaler argued that the cols of the first stage were due to subglacial streams. J. W. Spencer, W. M. Davis and H. S. Williams brought up minor points, after which adjournment was made for lunch.

The Society met at 2 and listened to an extended paper by Professor B. K. Emerson, of Amherst, on 'The Geology of Hampshire, Hampden and Franklin Counties, Mass.' These are the three counties along the Connecticut river in Massachusetts. They embrace Archean crystalline rocks, metamorphosed Cambrian and Devonian sediments, Triassic sandstones and traps, Glacial deposits and Champlain clays. The speaker illustrated his remarks by large maps, the results of nearly twenty-five years of study. His address was divided into three heads. He first took up the Archean and paleozoic rocks. The former are in the continuation of the Green Mountains and lie on the west side of the valley. Among other things they embrace a great belt of granite containing inclusions of marble, and a great belt of hornblende schist on which rests the emery bed at Chester. On the older crystallines lies unconformably the Cambrian conglomerate now metamorphosed to gneiss, and the same appears at Monson on the east, where it is quarried as granite. The Devonian beds appear at Bernardston and exhibit remarkable contact metamorphism. The second part of the paper dealt with the Triassic sandstones and traps. The dikes, plugs, tuffs, and the faults characteristic of this series were described. The third part of the paper discussed the glacial deposits, Champlain clays and the variations in the channel of the Connecticut river in the formation of oxbows.

The address was the most important of the meeting and was listened to with close attention by all present.

The next paper was by W. B. Clark, of Baltimore, 'On the Eocene Fauna of the Middle Atlantic Slope.' The speaker reviewed our previous knowledge of the forms of life of this period and detailed the great increase in the number of species and in the sharpness of their determination that had resulted from the explorations of the last few years. The faunas were now so well understood and established as to be of great stratigraphic value. The paper was followed by R. T. Jackson and T. A. Jaggar, of Cambridge, Mass., on the 'Arrangement and Development of Plates in the Melonitidæ.' The anatomical structure and life history of this group of echinoderms were described. The next paper was by Wm. H. Hobbs, Madison, Wis., 'Pre-Cambrian Volcanoes in Southern Wisconsin.' The speaker presented a preliminary report on the study of a group of isolated areas of igneous rocks which protrude through the Potsdam sandstone in the valley of the Fox river, Wisconsin. Some of these areas represent local outflows of rhyolitic lava which exhibits superb examples of spherulitic, perlitic, fluxion and breccia structures. The originally glassy ground mass of these rocks has become devitrified; hence they are apo-rhyolites, and they have been subjected to dynamic metamorphism and subsequent infiltration of silica. They are intruded by dikes of both basic and acid rocks. Specimens and photographs of sections were exhibited.

The succeeding speaker was A. Capen Gill, of Ithaca, N. Y., on 'A Geological Sketch of the Sierra Tlayacac, in the State of Morelos, Mexico. The Sierra Tlayacac, situated to the southward of the great fault-line described by Felix and Lenk, consists of a projecting group of mountain tops in the midst of the Morelos Plain. The plain is formed by the lava streams and ejectamenta of Popocatepetl or neighboring volcanic vents. The tops of the nearly submerged mountains show that the folding and elevation of the Cretaceous (Caprina?) limestone was accompanied or followed by the deposition of a limestone conglomerate, in the pebbles of which are also Caprina (?) fossils. Lack of eruptive pebbles indicates that the volcanic activity of the region was subsequent to extensive folding and erosion.

The limestone conglomerate is overlain by an acid eruptive, and both rocks are cut by numerous dykes which show a close 'consanguinity' with the recent extrusions of Popocateptl. The very striking metaphorphism produced by these dykes corroborates the view that there is little, if any, migration of material from the intruded mass into the metamorphosed rock.

Heated water and steam would appear to be the principal agents of metamorphism, rather than heat alone, since the great distance to which recrystallization has reached seems dependent on the *porous character* of the rock before alteration.

Garnet, vesuvianite, wollastonite and pyroxene are among the minerals developed, and large crystals have been found at a distance of several hundred feet from the contact.

Considerable discussion followed in which the forbearance of the author in refraining from the creation of new rock-names, was heartily commended.

The session then adjourned until 9 A. M. of Wednesday. On reassembling the following morning the first paper was presented by W. M. Davis, Cambridge, Mass., on 'The Bearing of Physiography on Uniformitarianism.'

The conditions and processes postulated in the physiographic study of land forms—geomorphology of some authors—are among the cardinal principles of uniformitarianism. The success in the interpretation of nature by means of this kind of study confirms the correctness of its postulates, and thus brings to the support of uniformitarianism a large class of facts, whose bearing on this theory was not at all perceived when its early advocates announced it. These general principles were further elucidated by the example of the development of the river Marne in northeastern France, and of its associated streams. The migration of divides and the robbing of one stream by another in the course of slow degradation were traced out as an illustration of large effects from the operation of slow and gradual causes. In discussion B. K. Emerson cited similar cases of the robbing of one stream's headwaters by another, in the relations of the Housatonic and Connecticut divides in western Massachusetts. President Shaler emphasized the importance of continental tilling in bringing about these changes of drainage, and illustrated his point by cases in the Berkshire Hills.

C. R. Van Hise, of Madison, Wis., followed with a paper on the 'Analysis of Folds.' As regards movement three zones in the constitution of the earth were cited, an outer of fracture, an inner of fracture and flowage, and an interior one of flowage alone. The particular depth or extent of each depends on the hardness or softness of the strata; shales, for instance, flow at a small depth. The subject of folds was then taken up, and it was shown that the ordinary treatment of the subject with sections in only two dimensions was incomplete in that it failed to properly emphasize the pitch of the axes and the presence of other

folds at angles with the first series. The relations of various smaller wanes as all parts of one great one were also brought out, and especially the association of minor overthrown anticlines with a central fan-shaped fold. The former incline toward the latter in case of fan-shaped synclines and away from it in corresponding anticlines. The paper closed with practical suggestions in taking and interpreting observations, but feeling pressed for time, the speaker passed over them with such rapidity that an appreciation of them will require the printed text. W. M. Davis in discussion referred to the three zones originally cited and asked if the speaker could estimate from the character of the flowing or fracture, shown by an eroded fold, anything about the original burden of rock that had been removed. Prof. Van Hise in reply stated that he thought it could be done within reasonably wide limits, say two to five thousand feet.

The following paper was by N. S. Shaler, of Cambridge, Mass., and was entitled 'On the Effects of the Expulsion of Gases from the Interior of the Earth.' The smaller cases of gases emerging from muddy river bottoms, lakes and swamps were first treated, and then the larger manifestations of the same at times of earthquakes, such as those at New Madrid and Charleston. The action was likened to the succession of bubbles in champagne or soda water. One getting started eases up the weight of the overlying column of water, so that many others follow in the same path. The lack of fossils or organic remains in mud and clay where they must have originally been abundant was explained by the dissolving action of these gases, especially while in solution. The explosion of vapors in volcanic conduits was then taken up, illustrated by the speaker's observations on Vesuvius and explained in the same way as the simpler cases.

Arthur Hollick, of New York, next presented a paper on 'Cretaceous Plants from Martha's Vineyard.' Results were obtained from an examination of the material collected by David White in 1889.

At the New York meeting of the Society in December, 1889, Mr. David White read a paper entitled 'Cretaceous Plants from Martha's Vineyard,' which was published in abstract in the proceedings of that meeting. The author subsequently published a more extended account in the *American Journal of Science* for February, 1890, and figured a few of the specimens which were most readily to be identified as cretaceous species. These papers were based upon material collected by the author and Mr. Lester F. Ward during the summer of 1889. The object of these papers was principally to demonstrate the occurrence of cretaceous strata in that island, hence only sufficient material for that purpose was utilized. During the present year all the material which was collected was turned over to him for examination and report, in addition to which there were a few specimens collected personally during the summer of 1893. The general results obtained indicated a flora parallel with that of the Amboy clays of New Jersey, but as the fossil leaves are found in concretionary sandstones which are mixed with the clays in somewhat uncertain relations, it is very desirable to obtain, if possible, remains in the clays themselves. The difficulty in preserving such as have hitherto been noted has prevented their study.

J. F. Kemp, of New York, then read a contribution on 'The Titaniferous Iron Ores of the Adirondacks.' The paper opened with a brief statement of the characters of the two kinds of iron ores which are afforded by the region, the merchantable magnetites and the titaniferous. The former are in gneisses; the latter in the gabbros and anorthosites of the Norian, which are believed to be intruded through the gneisses.

A list of localities of the titaniferous ores was given and the distinction was made between the smaller bodies which are, so far as can be seen, basic developments of gabbro, and the enormous ore bodies at the old Adirondack Iron Works, in the heart of the mountains. These latter are in massive anorthosite, which is almost entirely formed of large, blue-black crystals of labradorite. The ore bodies, and especially the one crossing Lake Sanford, contain numerous included labradorite crystals, each of which is surrounded by a reaction rim 5–10 mm. across. It was further shown that the wall rocks show no signs of the widespread crushing that is exhibited in the general 'mortar-structure' of the Adirondack and Canadian anorthosites, but are plutonic rocks free from evidences of dynamic metamorphism. The argument is then made that the ores are segregations from an igneous magma formed during the process of cooling and crystallization. In conclusion the speaker gave some notes on recent attempts to utilize these ores that bid fair to be successful.

In discussion, C. R. Van Hise mentioned the similar bodies of titaniferous ores in the gabbros of Lake Superior, adding, however, that there had been some infiltration of iron oxide since the formation.

The last paper of the meeting was presented by J. C. Branner, of Stanford University, California, on 'The Decomposition of Rocks in Brazil.'

The decomposition of rocks is much more profound in Brazil than in temperate regions. This decay has lately been demonstrated by railway cuts and tunnels and by deep mines, records of which was given. This decomposition is produced by mechanical and chemical agencies.

The chief mechanical agency is daily change of temperature suffered by rocks openly exposed to the sun—about 100 degrees Far. This causes exfoliation of mountain masses and of boulders and open crevices that admit water, air, insects, and these set up a train of reactions that soon destroy the rock. Chemical agencies are organic and inorganic. The inorganic agencies are carbonic and nitric acid brought down in rains in great quantities. The organic chemical agencies are insects and plants. The ground is then filled with vast hordes of ants whose breath and food form acids that attack the rocks. The rapid decay of a very rank vegetation contributes the chief agent of rock decomposition. Rain falling on hot rocks greatly increases the action of these agents. The paper was illustrated by sketches and photographs and excited the deepest interest.

On account of the absence of the authors and the need of adjournment in view of an excursion that was offered by Professor Emerson to Mt. Holyoke in the afternoon, the following papers were only read or announced by title:

George M. Dawson and R. G. McConnell: 'On the Glacial Deposits of Southwestern Alberta,' in the vicinity of the Rocky Mountains. Warren Upham: 'Drumlins and Marginal Moraines of Ice-sheets.' N. H. Darton: 'Notes on Relations of Lower Members of Coastal Plain Series in South Carolina.' N. H. Darton: 'Resumé of General Stratigraphic Relations in the Atlantic Coastal Plain from New Jersey to South Carolina.' George P. Merrill: 'On Asbestos and Asbestiform Minerals.' C. A. Gordon: Syenite-Gneiss (Leopard Rock) from the Apatite Region of Ottawa County, Canada.

The regular meeting adjourned after passing a vote of thanks to the Library Association of Springfield, and to the Local Committee.

In the afternoon thirty-seven fellows accompanied Professor Emerson to Mt. Holyoke to see the contacts of trap and sandstone, the dikes, plugs, bird-track and other

phenomena of the Triassic. Before the meeting a more extended trip was taken by a good sized company. Professor Wm. H. Hobbs guided them through the interesting metamorphic region of the Berkshire Hills. They were met at Pittsfield by Professor Emerson, who took them to Chester, Bernardston, Turner's Falls, and other points of interest in the Connecticut Valley.

On the whole the meeting was an interesting and well attended one, but, as in previous summers, the fellows of the Geological Society to a very great extent returned to their homes on its conclusion. The meetings of Section E of the American Association are thereby crippled, and the question was raised in the minds of not a few, who have the interests of Section E likewise at heart, whether it is on the whole wise for the Geological Society to hold other than a business meeting, in the summer, for which there would always be a sufficient number of fellows on account of the meetings of the American Association. It is also a question whether it is wisest for the American Association to have for its meetings a week broken by Saturday and Sunday. The temptation for members to go to their homes on Saturday is wellnigh irresistible and comparatively few return. As a result. the final sessions have few attendants and the available candidates for sectional officers who are actually present on the day of election are few. A session beginning Tuesday and closing Saturday would have many advantages.

J. F. KEMP.

COLUMBIA COLLEGE.

*THE RELATIONS OF THE INDUSTRIES TO THE ADVANCEMENT OF CHEMICAL SCIENCE.**

WE justly congratulate ourselves that development and progress in chemistry, both in science and technology, have been more rapid in the past three decades than ever before, and that as much has been accomplished in this period as in all the years preceding since reactions have been known and applied. New elements, new compounds, new theories and new laws have followed each other in the manifold directions with such enormous rapidity that few have been able to keep informed of all, and most of us of only a few, of the discoveries and generalizations that have been made. It is for the purpose of exchanging information on these subjects that we come together at the present time, and it has been the custom of the Chairman to discuss one or another of these lines of progress, setting forth the most important of what has been developed in the more recent times. In many of the discussions and addresses on similar occasions by those more or less closely allied with or engaged in the study of so-called pure chemistry, much has been said of the practical value of the results obtained in the scientific laboratories devoted to research, and the uses they have found in daily life. No one has arisen to question the truth of what has been said, nor could it be questioned, for the men who have been working with the most unselfish devotion to the pursuit of truth for truth's sake, and with little hope of reward for the service they have rendered, have acquired and disseminated a store of knowledge which has added so largely to the capacity of all men for work that only the most grateful acknowledgments may be offered. While all this may be accepted, it is seldom that anything is heard regarding the reciprocal influence of the industries and the ordinary occupations of daily life upon the development or advancement of chemical science, and it has seemed that, in this period of relaxation, it would be well to stop and consider what are the relations of the industries to the science from the other

*An address before the American Association for the Advancement of Science, August 29, 1895, by the Vice-President, Section C.

side of the question, and what aid has come from the former to the latter to promote its advancement, if, indeed, any distinction can be made so far as the additions to human knowledge are concerned. For science is cosmopolitan, as it were, and omnivorous, and facts from whatever source, and of whatever kind, are greedily absorbed to form a part of the grand structure of human knowledge, whether they come from efforts made at leisure and in the quiet of the study or private laboratory, or whether they are developed in the struggle for existence and the daily bread.

In its earlier development, substantially beginning with the present century, chemistry was the newest of the physical sciences. It grew up out of the empiricism of the preceding centuries and had its foundation in the facts to be found in the daily practice of those engaged in the endeavor to meet the demands of the current needs. As civilization progresses, culture extends, demands consequently grow, and it is one of the inevitable laws of sociology and political economy, as of nature, that these demands shall be met. To meet them human ingenuity must be taxed for the determination of methods and means; and whether it be to secure immediately useful results or to establish more abstract truths, intellectual endeavor is required, knowledge must be increased and science therefore advanced. Literature is filled with description of the service which the science of chemistry has rendered to the industries and the commercial world, and the development of the tar color industry is the favorite example of this so frequently cited. History, so far as it is written, for the most part deals with the subject from this standpoint. But it may properly be questioned whether the industry was wholly the outcome of scientific research or whether science received much, at least, of its inspiration, its suggestion, its original material from the industry already developed in an intensely empirical way. It is this side of the question that will occupy us at the present time, and we shall endeavor to call attention to some of the influences which operate from one side or the other to bring about the results indicated and to the reciprocal influences which flow from the results themselves.

The true fundamental principles of the science were not developed and set forth through the classic researches and deductions of the great leaders, Dalton, Priestley, Cavendish, Black, Wenzel, Richter, Lavoisier, Gay Lussac, Avogadro, Dulong and Petit until the close of the last and the earlier years of the present century. But even before the beginning of the last century the rapid progress of civilization and culture in other lines had made demands for the products of the chemical arts, and they were met in ways that were empirical it is true, but by reactions which were as positive then as they are now, even though they were unknown, and they furnished fertile food for study and speculation on the part of the philosophers in fields quite new to them, led them out from the libraries of the monasteries to the active work of the busy world, furnished them with facts for collaboration and classification, from which they were amply able to construct the hypotheses and build up the theories which have been of so much value to the civilized world. During the entire century the industries thrived and grew, met the demands put upon them and brought about the establishment of facts that long since were recorded as new discoveries.

The acknowledged fathers of the science of chemistry, although eminent scholars and connected with the institutions of learning, were many, if not most of them, directly interested in the manufacture of chemical products, and by their general education and higher intelligence were enabled to contribute to their material advance-

ment. At the period in which these men lived and worked, these industries could with difficulty meet the demands of the advancing civilization, and that they were profitable then, even as they were later, we learn from the experience and writings of Chaptal,* who was turned from the profession of teaching to establish at Montpellier, as he tells us, large works for the manufacture of sulphuric, nitric, muriatic and oxalic acids, alum, copperas, sal ammoniac, sal saturn, white lead and the preparations of lead, mercury, etc. He declares that he had made 'mountains of alum without being able to crystalize it,' until he had, through the analysis of Roman alum, determined the presence of potash in the crystallized product. And in order that he might have proper apparatus for his works he undertook the manufacture of the porcelain and pottery he required. A little later he became interested in dyeing and calico printing in a commercial way. How profitable this manufacture was may be gathered from the fact that after the political reverses which brought about his deposition from the public life in Paris which had consumed his entire fortune, he returned to his manufacture at Montpellier and in a single year realized from it a handsome net profit of 350,000 francs. He further relates that, encouraged by his success, other chemists of France established large manufacturing works and entered into their management. He was closely associated with Lavoisier, Berthelot, Monge, Fourcroy, Carny, Vandermonde, Guyton de Morveau and others in the manufacture of gunpowder near Paris, and his memoirs show that during his residence at Montpellier he was in constant correspondence with the chemists of Paris and elsewhere. Dubrunfaut† states that at the instigation of the Comptroller-General, Turgot, the Academy of Sciences of Paris offered a prize in 1776 for the invention of a method for the production of niter and that Stahl and Lavoisier did not disdain to take an interest in the subject of the prize. It amounted to £3000 and was awarded to Thouvenel, who was required, we are told, to justify experimentally the theory of Lavoisier. At that time Lavoisier was director of the Royal Saltpeter Works. Berthollet* was interested in bleaching and dyeing, suggested the use of chlorine for the former and in 1791 published a work entitled 'Elements of the Art of Dyeing.' Guyton de Morveau† was devoted to analytical and technical chemistry, and among other things he founded saltpeter works in 1773 and soda works in 1783.

* La Vie et l'Oeuvre de Chaptal. p. 31.

† Le Sucre. II., 95, note.

Much of the work, therefore, not only of Chaptal but of other chemists of his time, was doubtless done in response to demands made upon them by the exigencies of the manufactures, but how many of the results they communicated to the journals and learned societies flowed directly therefrom we are not told. Certainly they could not have failed to study closely the phenomena thus offered for their observation and which in many respects could not have been as efficiently exhibited in any other way.

So also, as we are told by Meyer‡ and other historians, the earlier contributors to the new science, Boyle, Kunkel, Bergmann, Scheele, Margraff, Macquer, Duhamel and others, were largely devoted to the development of certain chemical processes in the industries. With all these men, the other great leaders of the science were closely associated; the problems constantly arising and the results obtained in their solution were doubtless subjects of frequent dis-

* Schaedler, Handwörterbuch der wissenschaftlich bedeutenden Chemiker.

† Schaedler, Handwörterbuch der wissenschaftlich bedeutenden Chemiker.

‡ Geschichte der Chemie, Zweite Auflage, 1895.

cussion and led them to profitable study regarding them and the fundamental and natural laws upon which they were based. And what was true of that earlier period of the history is true to-day and to an increasing degree must find illustration in future work. The industries are still pushing forward with earnest competition to supply the demands which grow with the years, and the hard questions which come from managers and proprietors to professional men are as numerous and as difficult in their way as those which puzzled the early philosophers and stimulate an earnestness in endeavor and investigation that brings the highest and most useful results. We must admit that without these hard questions the advances in the science itself would be less rapid and the intellectual activities of investigators less alert.

Beautiful illustrations growing out of such demands are everywhere to be seen at the present day even as they were in former years, although they are not often to be found recorded in the pages of published history. Many of us will remember the incident cited by Hoffmann* in his necrological notice of Dumas describing the circumstances which led to the discovery of the absorption of chlorine by organic bodies, in which he declares that it "is not generally known that the theory of substitution owes its source to a soirée in the Tuileries." Dumas has been called upon by his father-in-law, Alexander Brogniart, who was director in the Sèvres Porcelain Works, and, as Hoffmann says, in a measure a member of the royal household, to examine into the cause of the irritating vapors from candles burned in the ball room, a demand to which Dumas readily acceded, because he had already done some work upon the examination of wax which could not be bleached and was therefore unmerchantable. He was readily led to the conclusion that the candles used in the palace had been made with wax which had been bleached with chlorine and that the vapors were hydrochloric acid generated in the burning of the candles. But examination of the wax of the candles showed that the quantity of chlorine found was greater than could be accounted for by its presence as a mechanical impurity, and from it Dumas was led to experiments which showed that many organic substances when heated with chlorine have the power to fix it, and from these results he was in turn led to the further generalization concerning the law of substitution. In this connection Hoffmann says: "This information upon the origin of substitution, which the author of this sketch had from the mouth of Dumas himself, is more than an interesting incident. We frequently see that like the Luxembourg palace, the Tuileries, besides their historical legends, have likewise scientific memories. How wonderful! A ray of sunlight reflected from the window of the Luxembourg, and accidentally seen by Malus through a plate of calcspar, revealed to him the phenomenon of double refraction, adding a new province to the domain of physics; while the acid vapors from a smoking burning candle in the ball room of the Tuileries led Dumas to study the influence of chlorine upon organic bodies, and finally led him to speculation upon this action, which for many years had controlled the science and even to-day has a mighty influence upon its development."

It would be difficult to follow Dumas through the hundreds of investigations he made in all the fields of chemical activity, clearing up the the questions arising in the various occupations of daily life and in all its departments, even as it would that of other men active in progressive work. Much of the work of Dumas, as shown by Hoffmann and the published records, was devoted to the solution of such questions,

*Berichte der Deutschen Chemischen Gesellschaft. 17 R. 667.

and much of his inspiration was drawn from them. It was an incident similar to that already described that brought Dumas to the reaction whereby hydrogen sulphide may be oxidized to sulphuric acid. He found the walls of one of the bath rooms at Aix les Bains covered with crystals of calcium sulphate, which could have no other source than the vapors liberated from the hot water. No trace of sulphuric acid could be found in the atmosphere of the room. The portières of the room soon acquired an acid reaction, which proved to be due to sulphuric acid. Dumas concluded that the combination of hydrogen sulphide with oxygen had occurred upon the wall itself, the porous surface exercising an influence similar to that of platinum black upon hydrogen and oxygen. A subsequent investigation showed that when air steam and hydrogen sulphide are passed over porous substances at from 40° to 50° C., and still better at 80° to 90°, sulphuric acid is quickly formed without inintermediate formation of sulphurous acid or separation of sulphur.

Similar instances are set forth by Hoffmann*—who seems to have recognized the value of the influences we here have in mind—in his necrological address upon Liebig, whose well-known devotion to the industries and their advancement is so familiar and interesting. Hoffmann says: "No branch of chemical industry has failed either directly or indirectly to receive benefit from Liebig's works." He calls attention to the study of the fat and acetic acid industries, and declares that the key to their peculiar operations is of his making, that the preparation of the prussiates and fulminates, the manufacture of the cyanides, the production of the silver mirror, were the result of Liebig's work. His interest in the problems of agriculture and of the nutrition of plants and animals, of physiology and pathology, led him not only to the development of many new industries, but to the establishment of many of the truths of science as well. His method for the production of artificial foods and concentrated animal extracts were not the smallest of his contributions to the industry, and the possibilities of their value and wide application in turn led to further investigation. Meyer,* quoting from Hoffmann, says: "If we could hold to view all that Liebig has done for the well-being of the human race in the industries, in agriculture or in the promotion of health, one can scarcely declare that any other scholar of his time has left a richer legacy to mankind."

And what Hoffmann has said of Liebig is also applicable to himself, for in many respects he rivalled Liebig in his intelligent comprehension of commercial and industrial needs and their value in suggesting new and fruitful lines of work. No question could be proposed to him that had not for him some germs of useful thought, and it was the utilization of such possibilities as came to him in this way that made him great. His genius for this will be illustrated in connection with the incidents in the coal tar color industry which show the relation of that great branch of human endeavor to the subject in hand.

It seems to make little difference to which branch of chemical work we turn for illustrations of the ideas just presented. The enormous losses suffered by Italy and France by the diseases of the silk worm, the deterioration of the wines and the diseases of farm animals, made demands upon the genius of Pasteur, and through his brilliant work and magnificent results attention has been directed to the field of bacteriology and fermentation, and almost a new science has been built upon it. What a mass of material has through this one branch of

* Hoffmann, Berichte der Deutschen Chemischen Gesellschaft, VI., 647.

* Geschichte der Chemie, 231.

work been added to the sum of human knowledge and what an impetus has it given to the advancement of science! The industries demanded relief from their losses, but the path to that relief is strewn with facts which have been utilized for the establishment of new principles; and the new principles, extended to the other industries, have widened still further the field and led to the study of the products developed in the growth and nutrition of the lower organisms with results the spread of whose influence it would be difficult to define.

Some of us will remember that a little more than a decade ago many of the leading chemists of this country were called upon to settle a commercial dispute in Chicago, turning upon the question of an admixture of fats in the adulteration of lards and that, on account of the lack of knowledge then prevailing regarding the exact constitution and reactions of various fats, it was impossible to arrive at satisfactory conclusions with regard to the mixtures submitted. It was embarrassing for chemists to admit the weakness, but it nevertheless had useful results. Since that time the development of knowledge concerning these products has been such that it is possible readily to determine in many cases, not only the components of such admixtures, but even the quantity of each component present.

Such illustrations in increasing numbers will occur to every one who may consider the history of the science and the industries from this point of view. The coal tar color industry, which has so frequently been cited and described as the direct outcome of scientific investigation, will serve admirably to illustrate further the relations we are considering. No one of the industries has been so rapid in growth or has attracted the same degree of attention from both scientists and technologists, or has had so wide an influence upon the progress of the other industries and scientific work. A brief review of the conditions of its development from the standpoint of this discussion will be of interest and will serve to show how much the purely scientific side of chemistry may be found to owe to the development of the technical side.

The origin of the crude product of this industry, the manufacture of gas, is comparatively modern. Though it was known in the latter part of the last century it did not find extensive application permanently until between 1830 and 1835. But from the time of its first extended application, its by-product, tar, became a troublesome nuisance and many endeavors were made on all sides to find some means for its disposition and utilization. It was consumed by burning, it was boiled down in open vessels and its residues used as preservative paint for wood and metals; its lighter and more volatile products were subsequently collected by condensation and put upon the market as a solvent for fats, waxes, rubber, etc., and this was used in the manufacture of varnishes. According to Lunge,* Accum was the first to boil tar down in close vessels and thus obtain volatile oil which could be used as a cheap substitute for turpentine. Dr. Longstaff declares that, in conjunction with Dr. Dalston, he erected the first distillery for coal tar in 1822 near Leith, and that the spirits obtained were sent to Mr. Mackintosh, while the residue was used for making lampblack. Roscoe states that the distillation was carried on near Manchester in 1834, the naphtha obtained being used for making black varnish with the pitch. So that the lighter distillates had been furnished to the markets some years before Mansfield began, in 1847, the distillation of the lighter oils to obtain products which might be used for lighting purposes. It was in the course of this work that he de-

* Lunge. Coal Tar and Ammonia. 189.

termined the composition of the lighter oils in the market and found that they contained a considerable quantity of benzene, a fact discovered by Hoffmann two years before. Supplies for the subsequent uses in the color industry were therefore possible.

It may be observed here that the discovery of this compound by the dry distillation of coal, *de novo*, in the laboratory, would have been practically impossible* since, according to Perkin,† 100 lbs. of coal yields only 0.85 oz. of coal tar naphtha, and 0.275 oz. of benzene. The operations of the industry carried out on a large scale are necessary to this,‡ and such operations we know and shall see have furnished to those working in purely scientific lines materials for study which has given the most important results and without which many of the relations would still be unknown.

But to proceed. With the commercial production of benzene, its derivative nitrobenzene was readily obtained in large quantities. It had been made, it is true, years before by Mitscherlich in 1834, from benzene of benzoic acid, and by Laurent a little later by the action of nitric acid upon light oil of tar. Collas, a French pharmacist, made it in 1848 in a large way in Paris and later Mansfield took up its manufacture from the product of his stills, putting it on the market as artificial oil of bitter almonds, or oil of Mirbane, to be used in scenting soap.

So aniline which Unverdorben produced in 1826 by dry distillation of indigo and called krystallin, and Runge first separated from coal tar by treating it with hydrochloric acid in 1834 and called blauöl, and Fritsche produced by digestion of indigo with potash and distillation of the product in 1840 and called anilin, and Zinin produced in 1842 by reduction of nitrobenzene with ammonium sulphide and called benzidam, remained a scientific curiosity the true constitution of which was not fully determined until some years after it had been produced by Bechamp by reduction of coal tar nitrobenzene with iron and acetic acid and Perkin had utilized it in the manufacture of mauve.

*Compare Roscoe and Schorlemmer, Treatise on Chemistry, III., pt. iii., 15.

† Jour. Soc. Arts. 1869. 101.

‡ Compare Hoffmann. Jour. Soc. Arts, 1863. 647.

And so the way for Perkin had been prepared. Both the industry and the science, so far as they had been able, had done their share: the industry, by efforts at the utilization of the products at hand and showing possible commercial profit; the science, in the struggle after new compounds. The spirit of the iatro-chemists still prevailed and substantial benefits flowed from it as of old. Perkin,* likewise in an effort to produce a compound valuable and scarce in the market and to effect the synthesis of quinine, produced aniline purple or mauve instead. Starting out, as he says, with the consideration of the empirical formula, he concluded that by the oxidation of allyl-toluidine he might attain his end. Describing his experiment, he says: "For this purpose I mixed the neutral sulphate allyl-toluidine with bichromate of potassium, but instead of quinine I obtained only a reddish brown precipitate. Nevertheless, being anxious to know more about this curious reaction, I proceeded to examine a more simple body under similar circumstances. For this purpose I treated the sulphate of aniline with bichromate of potassium. The mixture produced nothing but an unpromising black precipitate; but, on investigating this precipitate, I found it to be the substance which is now, I may say, a commercial necessity." Perkin treated the black precipitate with different solvents in the study of its properties and found it to yield to alcohol a colored solution. With more of the inventive and commercial spirit

*Chemical News, 1861. 347.

than prevailed with his illustrious teacher in whose laboratory he was working, he at once began experiments to determine whether this new color, so beautiful in its hues, could be fixed upon textile fibers, and succeeded in dyeing a strand of silk with it without the aid of any mordant whatsoever. He promptly submitted his discovery to Puller, of Perth, who tried the color in a larger way, proving its commercial value. The patents were secured and Perkin at once devoted himself to the industrial production of the color and, after more or less difficulty, always incident to the manufacture of a new substance, he attained commercial success. The tar color industry was launched; it was immensely profitable; it furnished incentive to further investigation and experiment in similar lines; a new field was opened up, and what a flood of results has come from it! In them both empiricism and rationalism have been represented, and the addition to the number of new substances whose properties and constitution have been essential to the establishment of new theories and new laws has been enormous and unprecedented in all the history of chemical work. The search after the production of a commercial product, yielded accidentally as it were, and almost empirically, the seed from which this great and flourishing tree has sprung.

For it must not be forgotten that, after Perkin had obtained his oxidation product of aniline and had found that some portion of it was colored and could be applied to the dyeing of fabrics, his study of its properties ended for the time being and it was not until 1863 that he was able to take up this subject and follow it to conclusion, establishing the constitution of the new compound.

The history of the coal tar color industry is full of examples of the production of new substances and new reactions by the industry of the highest importance to the advancement of knowledge in the domain of chemistry and to the development of the great theories to which, in turn, much of progress both in science and technology has been due. In this connection one may study, with profit and interest, the very able address of H. Caro* before the Berlin Chemical Society, on the subject of the 'Development of the Coal Tar Color Industry.' While very properly giving the fullest credit for the scientific or rational work done in this connection and the applications of it in the industries, he shows many examples of the important results attained by technical or empirical methods and of the highest interest and value to the science. He calls attention to the fact that C. E. Nicholson suggested to Hoffmann that pure aniline would not yield aniline red, and that it was not the true agent for the production of this compound. A gallon of aniline with a constant boiling point of 220° C. sent to Hoffmann by Nicholson gave such a result; while a sample of the ordinary aniline of commerce, and boiling at from 182° to to 220°, yielded an abundant quantity of color. From this Hoffmann concluded that the commercial aniline contained a second base which, together with aniline and homologous with it, entered into the reaction to produce the regular result. But Hoffmann† declared that, if such an admixture of bases existed, their separation by any other than operations on a large scale would be out of the question, a condition found by other investigators. Nicholson had already suggested the presence of toluidine in the mixture. Hoffman tried making the color with pure toluidine from tolu balsam sent him by Muspratt and found that this, too, gave a negative result. But upon mixing the pure aniline from Nicholson in proper

*Berichte der Deutschen Chemischen Gesellschaft, 25, 955.

† Berichte der Deutschen Chemischen Gesellschaft, 25, 976.

proportions with the pure toluidine from Muspratt, the proportions corresponding with one molecule of benzene to two molecules of toluene, the red color was promptly produced. In this connection Hoffmann said 'the industry was ahead of the science' and Caro said: "Hence the industry was not only the generator of aniline red, but furthermore it had opened up the way to the rational utilization of benzene and its homologues for all present and future uses of color manufacture."

Artificial alizarine has much the same kind of history. It was developed by Graebe and Liebermann by most rational methods and from the constitution and reactions of the body itself. Starting with a commercial body, produced by industrial methods and in most empirical ways, they endeavored to reproduce it by rational synthesis and succeeded. Their method through dibromanthraquinone was not, however, a commercial possibility, and it remained for Perkin, with his industrial experience and capacity, and his engineering skill combined with his knowledge of chemistry, to overcome the manufacturing difficulties and to attain this end by other means and reactions than had been proposed by Graebe and Liebermann. The process proposed by the latter was precluded by the high cost of bromine and Perkin replaced it by sulphuric acid, producing the anthraquinone sulphonic acids which yielded after the melt the product desired. The industrial genius of Perkin gave artificial alizarine and with it a long series of products and problems for study and solution by chemists everywhere. It taught reactions that were fertile in stimulating new research and established facts that could not be, or at least were not, discovered in the laboratory. For instance, in the course of the manufacture, Perkin found that when, as sometimes happened, sulphonation of the anthraquinone was not thoroughly effected through insufficient heating or use of too little acid, a really better product was obtained than when the process had proceeded normally. He found that in the latter case the color of the resulting product was less brilliant than when these irregular conditions prevailed; that, in the latter, the resulting paste was a mixture of colors, while with the former nearly pure alizarine was the result. Investigation confirmed the outcome of the practice and showed that from the anthraquinone monosulphonic acid only pure alizarine was produced, while from the result of higher sulphonation a mixture of products was secured. Such a discovery may have been possible only in the larger way occurring in the works and might have long been overlooked in the laboratory. At any rate it was brought out in the industrial operation of the reaction, and a new fact was added to the sum of knowledge.

This discovery brought further necessity and new invention. By the ordinary method of sulphonating then employed, the monosulphonic acid could not readily be produced and it remained for Perkin to advance both science and technology still further by the determination of a new process for attaining this end. He found* that dichloranthracene which is easily made may be as easily sulphonated and that the dichloranthracene sulphonic acid is readily converted to the anthraquinone sulphonic acid by heating with sulphuric acid, the final result depending upon the degree of heat employed in the reaction in sulphonating the dichloranthracene. He had thus not only advanced the industry in this branch of manufacture, but he had added to the list of reactions and compounds in chemistry as well.

Hoffmann received from the French color works the *queues d'aniline*, from which he was able to separate para toluidine and the

*Jour. Soc. Arts. 1879. 577.

two new bases paraniline and paramidophenol.* Other products from the same residues enabled the great investigator to arrive at a knowledge of the mode of formation and structure of rosaniline. Later another French color-maker sent Hoffmann a well crystallized by-product which he recognized as meta-toluylendiamine which he, together with Muspratt, had endeavored to make by synthesis. He found it to have been undoubtedly produced by the Bechamp method from nitrobenzene contaminated with dinitrotoluene.

In his most interesting and valuable address, from which many of these illustrations have been obtained, Caro calls attention to other instances of contributions to the advancement of science from this great industry; the use of zinc dust in strongly alkaline solution for the reduction of nitro-bodies was worked out in the factories; safranine was produced technically several years before its structure and mode of formation were made out by Nietzki. The empirical formation of nitrodracylic acid and β naphthylamine is cited as furnishing contributions to the establishment of isomerism in the classes to which they respectively belong. Aniline blue, produced empirically by heating together fuchsine and aniline, was found later by Hoffmann to be triphenylated rasanilin† and led him to the recognition that change of color could be produced by substituting an alkyl, phenyl or benzyl radical for hydrogen; and so started the theory, now developed into a law, that color of compounds is a function of structure, and that, in those compounds, having antifermentive, therapeutic or toxic action, the influence will vary in intensity with the position of the radical in the molecule. Thus it has been found that ortho-cresol is less active as an antiferment than the meta-compound, while this in turn is less intense in its action than paracresol. α Naphthol is more poisonous and more actively antiseptic than β naphthol.

* Proc. Roy. Soc. 1863. 312.

† Proc. Roy. Soc. 13. 9.

The field of chemical work, here so wonderfully opened up, has done much to bring into closer contact and communion the professional men and investigators on the one hand and the practical technologists on the other. Professional men find that such union furnishes valuable material for study and most useful suggestions for work. As Hoffmann says, "the technologist is not likely to leave long without utilization any fact of science which may be developed and made valuable from the technical side;" so we find that the benefits which flow from each to each are rapidly increasing from year to year and the distinction formerly made between science and technology is rapidly being broken down, and more cordial, and therefore more useful, relations established. Such union for progressive work was established with profit to both sides by Hoffmann and Nicholson, Graebe and Caro, O. Fischer and E. Heppe and others, and the example of these authorities has been followed by the great manufacturers in all countries by the foundation in the works, of well-equipped laboratories, intended not only for control of processes by analytical methods, but for the improvement and extension of processes by careful research methods and the discovery of new principles. Ostwald* has clearly set forth the manner in which technology and science may work together in electrical work, in the various directions.

How rapidly this practice has grown will be illustrated by the fact that the great works, successors to Meister, Lucius and Bruning at Höchst, made, in 1890, from 1700 to 1800 colors† and employ 3000 per-

* Chemische Industrie. 1895. 212. From Zeitschrift für Electrotechnik und Electrochemie. 1894. 81.

† Ost. Lehrbuch der Technischen Chemie.

sons including 70 chemists and 12 engineers.* K. Oehler & Co., in Offenbach, have 300 workmen and 45 chemists.† Other works of large capacity like the Badische Anilin und Soda Fabrik of Ludwigshafen, Bayer & Co. at Elbersfeld, Casella & Co. in Frankfurt a/m likewise employ large numbers of educated chemists and engineers. This practice now extends to most of the more important manufactures. Its value was early recognized in metallurgy and it has been adopted in other lines. As a consequence a demand has been made upon the educational institutions and an influence has been exerted upon the management leading to provision of better facilities for work both in investigation and instruction.

In connection with the working force of the German color factories, it is worthy of remark, that experience has led directors to employ educated engineers alongside the research chemists and so to recognize the fact that engineering capacity is necessary to the practical and industrial application of chemical reactions. These reactions effected in the laboratory cannot always be obtained in the works in a large way without the invention of special apparatus, and frequently the most brilliant discoveries in science prove to be nothing more than mere suggestions to the industries, doubtful stepping stones to new processes or new products. The discoveries of aniline and alizarine are examples of this principle. The ammonia soda reaction remained dormant nearly half a century until it was made practical through the genius of Solvay and by means which scarcely involved chemical reactions. The Leblanc soda process, with its beautiful reactions—partly, it is true, because of the political situation—remained dormant nearly a quarter of a century before the genius of Muspratt restored it to life. The sugar industry, the conception of Margraff and Achard, required the invention and construction of much special apparatus before it could develop into the astonishing dimensions it presents to-day. The Weldon process could be established in the industry only after a most earnest struggle extending over three years, and the final result showed that the complete reaction could be obtained only when working in the largest way.

The study of the ultimate history of any or all of these industries will show that, as they grew, they made demands upon the educated men and so both directly and indirectly contributed to the sum of useful knowledge in nearly all its branches, chemistry included.

For this reason the demand is growing for a combination of chemical and engineering knowledge in the same person. The value of this has been noticed in the lives and works of many of the leaders in chemical work, and its recognition among educators is advancing. This is illustrated in the views of Victor Meyer,* expressed as follows: "I coincide completely with Dr. Lippmann in his wish not only for an extension of his technical instruction in our own university in its present scope, but also for the further development of the same, and I would add thereto the expression of my own opinion that instruction in technical drawing ought not to be omitted in the curriculum of any university in which numerous young chemists seek their education and are likely ultimately to desire occupation in factories and works." Similar expressions have come from other high authorities in the field of education, and the wisdom of the establishment of the technical schools with provision for thorough education in all the special branches that may find useful application in the

* Grandhomme. Die Fabriken der Actien-Gesellschaft Farbwerke Meister, Lucius und Bruning.

† Dir. E. Franck. Zeitschrift für Angewandte Chemie. 1895. 444.

* Chemical News, 1894, 97.

different industries is thoroughly confirmed.

Thus far no reference has been made to the influence of the industries upon the development of analytical chemistry, and perhaps for this there is no need. It is generally accepted, or is fast growing to be, that it is an integral part of all technical work involving any kind of chemical reactions. Meyer* says: "The industry practically developed volumetric analysis. It was first used by Decroizelles and Vauquelin in an empirical way in the chemical industries with which they were connected and was finally developed rationally by Gay Lussac, who brought it to a state of perfection not greatly improved upon in many respects."

The industries of the earlier chemical history were controlled by other methods of analysis also, crude, perhaps, but serving a useful purpose and forming the foundation of the beautiful systems in use to-day.

In this particular the requirements of the industries of the present day are most exacting. Technical methods as distinguished from scientific methods have passed away, for with rapidity of operation that many of the processes call for, the utmost accuracy must likewise prevail. This is particularly true of the metallurgical industries in which many of the operations must be controlled by analysis from hour to hour. So, too, the utmost accuracy is demanded in all work controlling commercial operations, and frequently the investigation required to confirm the value of these so-called commercial methods, or the data upon which they are based, brings forth results both as to quality and quantity that are most gratifying. In at least two cases that have come to my knowledge the directors of the laboratories of great educational institutions made requests to the directors of large chemical works, asking for descriptions of the analytical methods in daily use in the works in question, and the request was of course cordially granted.

* Geschichte der Chemie, 339.

And if the analytical methods of the technical side are recognized as of value, so too are the experimental methods. In the great German chemical works, where large numbers of chemists are employed, the force is divided into 'laboratoriums Chemiker' and 'betriebs Chemiker,' each class having its appointed work;* the first class devoted to the investigation of new ideas in the smaller way in the laboratory, producing new compounds or investigating new reactions, or, still further, controlling by analysis the operations in the works; the second class experimenting in a larger way, with larger apparatus and quantities, and even with the normal factory facilities; with either new principles deduced from the results of factory work, or with processes or products worked out in the laboratory. The results of this combination are extensive and important; most of them are covered by patents, it is true, but they are nevertheless offered to the world, soon become public property and add to the store of knowledge. How much this really amounts to is illustrated by the fact that the records show that the works of Fr. Bayer & Co. patented or described in the first half of 1895 forty-five processes and products, while during the same period there were issued to the house of Meister Lucius and Brunning thirty-seven patents. The number of specifications for chemical patents† accepted in Germany from 1889 to 1893 were respectively, 4,406, 4,680, 5,900, 6,430. Of these patents Dr. Freidlander‡ says: "If one could be certain of the excellence of all these compounds, a new era in the color industry would be imminent. Manifestly, however, even the patentees themselves find it diffi-

* Caro, Berichte der Deutschen Chemischen Gesellschaft, 25, R. 967.

† Chem. Zeit. 1894, 136.

‡ Chem. Zeit. 1894, 1184.

cult to recognize instant practical value in them. The numerous naphthyldiamine, amido-naphthol and dioxynaphthaline sulphonic acids were patented, not indeed because a special technical interest was claimed for them, but only because they were new and it was scarcely possible at once to determine whether they would be applicable in one direction or another."

In no direction has the application of the methods in the larger way, either in the laboratory or in the works, given richer yields in new material than in the varied uses of the electric current in chemical work. It has led to the production of new compounds or has increased the means for production of old ones, and through it additions are constantly being made to the store of material of such composition and properties that they must inevitably lead to further new discoveries or the establishment of new principles or laws. It has added greatly to our knowledge of the reactions of oxidation and reduction and has made new applications of those phenomena possible. In this connection we may refer to the processes of Hoepfner and of Siemens and Halske for the extraction of copper from its solutions, whereby, as the metal is removed from the solution at the cathode, the reduced salts are oxidized at the anode, and the solutions thus brought to the higher state of oxidation are ready for use on new portions of ore.* Similar reactions occur in the new process of Löwenherz for the production of sodium persulphate, a compound new to chemistry and resulting from the application of electricity on a scale more extended than is usually employed for laboratory work. Sulphuric acid and sodium sulphate solutions, separated by a porous diaphragm are electrolyzed with the anode immersed in the sodium sulphate. The resulting compound is comparatively unstable, yielding up its oxygen with the production of acid sodium sulphate. And since this latter may readily be neutralized by sodium carbonate, the new compound is recommended for all uses in which oxidation may be applied.*

With the production of hypochlorites and the chlorates we are already familiar. It grows rapidly with the cheapening of artificial power or the utilization of natural power, until eventually the world's demand for them must be covered by materials from this source. The reaction necessary to this is further utilized in the production of such compounds as chloral, iodized phenol and other similar substances.†

In the field of reductions reference may with interest be made to the late discoveries of Gattermann and the color works of Fr. Bayer & Co., that electrolysis is readily applied to the production of a large number of compounds not heretofore produced technically but for which technical uses constantly exist. Their earlier discovery of the application of electrolysis to the reduction of nitrobenzene to amido-phenol with intermediate production of phenyl-hydroxylamine finds wider application than they at first supposed and will doubtless constitute the starting point of a new line of synthesis of the carbon compounds.‡ This reaction is similar to that of zinc dust in alkaline solutions, preferably in alcohol containing calcium chloride whereby, as noticed by Wohl and Bamberger, phenyl-hydroxylamine is produced instead of the aniline produced by the reduction with acetic acid and iron.

The electrical smelting furnace has opened up a wide field of experiment and investigation as fascinating as it is new, and it is to be expected that many additions will be made to the list of new substances through its use. The increased production of chromium and the crystallization of carbon by

* Zeitschrift fur Angewandte Chemie, 1893.

* Zeitschrift fur Angewandte Chemie, 1895, 349.

† Chem. Zeit., XIX.

‡ Chem. Zeit., XIX., 1111.

Moissan,* the production of carborundum by Acheson, the production of the various carbides by Moissan, Wilson, Borcher and others are of great interest from both the technical and scientific side. Whether the calcium carbide, which has been so much discussed and seems such a valuable material for the production of acetylene, will at once take and hold the high position assigned to it by its inventors is still an open question. But whether it shall find extended application in the industries or not; whether it will prove too expensive to compete with benzene as an enricher of an illuminating gas, or as a raw material for the synthesis of alcohol or other substances in a commercial way, it will serve as a convenient and sufficiently inexpensive source of acetylene for experimental purposes, and it will therefore without doubt still become the starting point for many valuable investigations. Nikodem Caro † has already applied the method of Berthelot to the syntheses of alcohol with acetylene liberated from calcium carbide and shown that the yields are so far from the theoretical amounts that immediate application in this direction is at least doubtful. But the results illustrate the possibilities of the advancement of the science through these technical or semi-technical methods.

It would be impossible in such a discussion as this to cover more than a few of the manifold ways in which the science of chemistry has been advanced by the industries, their wants and their wastes. The former have led to the establishment of the great systems of technical schools provided with the magnificent library and laboratory equipments, the state and national experiment stations, the various official boards and commissions for the study of those questions which immediately affect the general welfare, and from each and all of these

* Chemische Industrie, 1895, 231.

† Chem. Industrie, 1895, 226.

sources come reports of advances which are most gratifying. The latter,* that is, the industrial wastes, gave us new elements and new compounds and so furnished the material for the establishment of new laws. The soap-boiler's lye gave iodine, the wastes of salt gardens gave bromine, the mother liquors from the springs gave caesium and rubidium, the acid chambers selenium and thallium, and the mines and metallurgical works gave gallium and germanium.

Whether we consider this side of the subject of the advancement of our science from one direction or another, we shall find ample encouragement for combination of forces and for closer union of professional and technical workers in our general field of activity. For the benefits from one side must bring reciprocal benefits from the other.† The principle of action and reaction is as true and as applicable here as in the great domain of physics. Necessity is the most natural stimulant to effort, and honest investigation must call to her aid all knowledge whatever its source and all methods however they may be acquired, and where this is the moving spirit progress is most active. Dr. Ostwald says most justly that "the secret of German industrial chemistry is the recognition that science is the best practice." Is it not equally true that practice which leads to the development of truth is the best science?

WILLIAM MCMURTRIE.

NEW YORK.

AMERICAN MICROSCOPICAL SOCIETY.

THE eighteenth annual meeting was held in the buildings of Cornell University, Ithaca, N. Y., August 21–23. It was characterized by a large and enthusiastic attendance and a very important program

* Roscoe and Schorlemmer, Treatise on Chemistry III. pt. III. 15.

† Garo. Ber. d. d. Chem. Gesell. 25, R. 991 Meyer, Geschichte der Chemie, 469–470.

both in papers and discussions. There were seven papers devoted to botanical subjects, ten to zoölogical and histological topics and fifteen to technical subjects relating to the manipulation of the microscope, its accessories and the material to be examined. Titles of some of the more important papers were the flagella of motile bacteria, by Dr. V. A. Moore, of Washington; corky outgrowths of roots, by Herman Schrenk, of St. Louis; the secondary thickenings of the rootstalks of *Spathyema*, by Mary A. Nichols, of Ithaca; the history of the sex cells from the time of segregation to sexual differentiation in *Cymatogaster*, by Professor C. H. Eigenmann, of Bloomington, Ind.; the morphology of the brain of the soft-shelled turtle and the English sparrow compared, by Susanna Phelps Gage, of Ithaca; the lateral line system of sense organs in Amphibia, by B. F. Kingsbury, Ph. D., of Defiance, Ohio; the primitive source of food-supply in the great lakes, by Professor Henry B. Ward, of Lincoln, Nebraska; formalin as a hardening agent for nerve tissue, by Dr. Wm. C. Kraus, of Buffalo, N. Y.; the use of formalin in neurology, by Dr. P. A. Fish, of Ithaca, N. Y.; and a practical method of referring units of length to the wave length of sodium light by Professor Wm. A. Rogers, of Waterville, Me.

The morning sessions (9:30 to 1) were regularly devoted to the reading and discussion of papers. Following these, on Wednesday afternoon the Society inspected the library and other university buildings and witnessed the ruling of micrometers with a Rogers dividing engine in the physical laboratory. In the evening President Gage delivered the annual address before the Society.

On Thursday afternoon the Society was treated to an excursion on Cayuga Lake by the citizens of Ithaca. The enjoyment of this excursion was greatly increased by the kindness of Professors Tarr and Williams, who explained the geological formations met at the various points.

In the business session on Friday afternoon the project for an international bibliographical bureau of zoölogy was brought before the Society by Professor H. B. Ward, and it was unanimously decided to present the bureau with the proceedings of the Society and also to grant a subsidy of $25 for the coming year.

For the coming year the following officers were elected: President, Dr. A. Clifford Mercer, F. R. M. S., of Syracuse, N. Y.; Vice-Presidents, Edward Pennock, of Philadelphia, and Miss V. A. Latham, M. D., of Chicago; Secretary, Dr. Wm. C. Krauss, of Buffalo, N. Y.; Executive Committee, Dr. C. H. Eigenmann, of Bloomington, Ind; Dr. Hermann Schrenk, of St. Louis, Mo., and Miss M. A. Booth, of Longmeadow, Mass.

The following is a complete list of the papers presented:

1. *Some Notes on Alleged Meteoric Dust:* MAGNUS PFLAUM.
2. *Corky Outgrowth of Roots and Their Connection With Respiration:* H. SCHRENK.
3. *A Practical Method of Referring Units of Length to the Wave Length of Sodium Light:* PROFESSOR WM. A. ROGERS.
4. *Some Peculiarities in the structure of the Mouth Parts and Ovipositor of Cicada septendecim:* PROFESSOR J. D. HYATT.
5. *The Lateral Line System of Sense Organs in Amphibia:* DR. B. F. KINGSBURY.
6. *The Chlorophyll Bodies of Chara Coronata:* PROFESSOR W. W. ROWLEE.
7. *Secondary Thickenings of the Rootstalks of Spathyema:* MARY A. NICHOLS.
8. *Comparison of the Fleischel, the Gower and the Specific Gravity Method of Determining the Percentage of Hemoglobin in Blood for Clinical Purposes:* F. C. BUSCH and A. T. KERR, JR.
9. *The History of the Sex-Cells From the Time of Segregation to Sexual Differentiation in Cymatogaster:* PROFESSOR C. H. EIGENMANN.
10. *A Fourth Study of the Blood Showing the Relation of the Colorless Corpuscle to the Strength of the Constitution:* DR. M. L. HOLBROOK.

11. *Two Cases of Intercellular Spaces in Vegetable Embryos:* K. M. WIEGAND.
12. *The Fruits of the Order Umbelliferæ:* DR. E. J. DURAND.
13. *The Action of Strong Currents of Electricity Upon Nervous Tissue:* DR. P. A. FISH.
14. *The Morphology of the Brain of the Soft-Shelled Turtle and the English Sparrow Compared:* SUSANNA P. GAGE.
15. *The Flagella of Motile Bacteria:* DR. V. A. MOORE.
16. *The Primitive Source of Food Supply in the Great Lakes:* PROFESSOR HENRY B. WARD.
17. *Some Experiments in Methods of Plankton Measurements:* PROFESSOR HENRY B. WARD.
18. *The Fruits of the Order Compositæ:* PROFESSOR W. W. ROWLEE and K. M. WIEGAND.
19. *The Spermatheca and Methods of Fertilization in Some American Newts and Salamanders:* DR. B. F. KINGSBURY.
20. *Cocaine in the Study of Pond-Life:* PROFESSOR H. S. CONSER.
21. *Paraffin and Colodion Embedding:* PROFESSOR H. S. CONSER.
22. *Formalin as a Hardening Agent for Nerve Tissue:* DR. WM. C. KRAUSS.
23. *The Use of Formalin in Neurology:* DR. P. A. FISH.
24. *The Lymphatics and the Lymph Circulation With Demonstrations of Specimens and Apparatus:* DR. GRANT S. HOPKINS.
25. *New Points in Photo-Micrographs and Cameras:* W. H. WALMSLEY.
26. *The Question of Correct Naming and Use of Micro-Reagents:* MISS V. A. LATHAM, M. D.
27. *A New Way of Marking Objectives:* DR. WM. C. KRAUSS.
28. *Demonstration of Histological Preparations by the Projection Microscope:* DRS. KRAUSS and MALLONEE.
29. *Improvements in the Collodion Method:* PROFESSOR S. H. GAGE.
30. *The Syracuse Solid Watch Glass:* DR. A. C. MERCER.
31. *A Metal Centering Block:* MAGNUS PFLAUM.
32. *A New Cell and a New Method of Mounting in Glycerin:* MAGNUS PFLAUM.

NOTES ON ENGINEERING.

THE BRITISH INSTITUTE OF MECHANICAL ENGINEERS.

THE Institute held its annual convention the first week in August at Glasgow, Professor A. B. W. Kennedy presiding. The principal papers and discussions related to the economics of gas production and of the water supply of cities as a source of hydraulic power. The list was brief but the papers valuable and purely technical. Mr. Biggart described the application of hydraulic apparatus in the operation of charging retorts and in drawing the coke. The result was the doubling of the output with a stated force of men. Some 200 of the machines described are already in use. If applied to the whole manufacture in Great Britain, the estimated saving would be some $2,000,000 annually on eight millions of tons of coal. Glasgow and other great cities have them in use. The manager of the Glasgow works stated that the machines used in their works on a half-million tons of coal annually are in use night and day and give no trouble whatever.

Mr. Ellington described the existing systems of hydraulic transmission of power in Glasgow and Manchester, where pressures of 1120 pounds per square inch had been adopted; the customary figure being 700 to 800. Their method of transmission was succeeding admirably in intermittent work, and especially for packing presses. This power was in use, here and there, in London for operating dynamos. The charge for water is equivalent to threepence per brake horse power per hour. In South America this method has been applied in extensive drainage.

THE CONGRESS OF SANITARY ENGINEERS AND ARCHITECTS.

REPORTS of the work of Congress held recently in Paris and attended by foreign as well as French professionals indicate that much remains still to be done to complete a modern satisfactory system. More questions were propounded than answered, by far, and many schemes proposed by members were found impracticable by those actually engaged in such work. Much was said of methods of economizing water with-

out restricting its necessary and desirable use, but no methods were found free from difficulty. The technical schools teaching sanitary plumbing were commended and their extension advised, as were the professorships of sanitation in schools of architecture. Wm. Trélat's system of heating rooms and his formulation of the theory—by no means new—that heat should be radiated into rooms from warm walls, and not introduced by heating the enclosed air, were strongly approved. One method of Mr. Trélat is that of superheating the room before it is required for use, and then, by opening doors and windows, replacing the heated by cold air, thus leaving the heating to be done by radiation from the walls, and yet giving the occupants cold air to breathe. Resolutions were passed in favor of baths in schools, of cheap working-class dwellings and other social and economic improvements. The attendance was about three hundred.

GENERAL.

THE largest steamer yet constructed for carrying freight was launched at Wallsend, G. B., recently. The 'Westmeath' is 465 feet long, 56 feet beam, 34½ feet moulded depth, and can carry 10,500 tons dead weight of cargo, or 14,500 tons by measurement. The bottom is double and constructed as a system of ballast tanks. The engines are triple expansion and work at 180 pounds pressure. The hull is by Swan & Hunter, the engines by the Wallsend Engineering Co.

ENGLISH express trains between London and Glasgow and Edinburgh have for many years had schedules calling for speeds of 50 miles an hour. This has now been bettered by the London-Aberdeen express, which is scheduled to make the 540 miles in 8¼ hours. This was accomplished by the first train a month ago, and with no apparent difficulty, making the mean speed including stops over 63 miles an hour, and probably at times between stations on level stretches above 70 miles.

PROFESSOR SYLVANUS THOMPSON, in a letter to the *London Times*, August 1st, protests against the prejudice attributed to Lord Kelvin and others in favor of continuous currents for general use, and states that experience indicated the alternating currents to be desirable for all but electrolytic work. The obvious advantages of simplicity and relative cheapness of the latter are in no other case considered by the critic to be in any important degree compensated by continuity of current. R. H. THURSTON.

SCIENTIFIC NOTES AND NEWS.

SIR WILLIAM TURNER (Journ. Anat. and Physiol., April, 1895, p. 424) after reviewing the famous examples of the so-called transitional forms between apes and man, and concluding that they are without exception human, gives a detailed account of Dubois' *Pithecanthropus erectus*. The fragments on which this 'genus' is founded are also thought to be human when the single molar tooth is eliminated. The author holds that, since the crown of this tooth is not worn, while all the sutures of the cranial vault are obliterated, the tooth is from another skeleton and in all probability that of an ourang.

PROFESSOR D. D. SLADE has written an elaborate paper on *The Significance of the Jugal Arch*. (Proc. Amer. Philosoph. Soc. xxxiv., May 13th, 1895, pp. 17.) A systematic review of the elements entering into the composition of the jugal arch in the mammalia is essayed. The author invites attention to the taxonomic value of the arch in genera and families, while acknowledging that the underlying forces which it is assumed have produced the various forms yet await elucidation.

AT the approaching meeting of the British Association for the Advancement of

Science, which convenes on the evening of September 4th, there will be in addition to the address of the president, Sir Douglass Galton, three public lectures, one by Professor Sylvanus P. Thompson on *Magnetism in Rotation*, one on *The Work of Pasteur and its Various Developments* by Professor Percy F. Franklin and a lecture to workingmen by Dr. Alfred H. Fison on *Color*.

THE eleventh International Congress of Americanists will meet at the city of Mexico from the 15th to the 20th of October. The meeting will be under the patronage of the President of Mexico and the most distinguished scholars and statesmen of the country. The Congress has for its object the study of the ethnography, languages and history of North and South America, with special reference to the period preceding the advent of Columbus.

THE Berlin Academy of Sciences announces that the Steiner prize (4,000 M. and an additional prize of 2,000 M.) will be awarded for a paper in continuation of J. Steiner's work on curved surfaces, which must be submitted before the close of the year 1899.

THE *Naturwissenschaftliche Rundschau* states that the 'Accademia dei Lencei' at Rome has elected as correspondents, Professor Luciani, of Rome; Dr. Stefani, of Florence; Professor v. Kölliker, of Wurzburg; Dr. Jordan, of Paris; Dr. Salmon, of London; Professor Ivanovitch, of St. Petersburg, and Professor Newcomb, of Washington.

PROFESSOR BERGH has been elected correspondent of the Paris Academy in the place of Huxley.

THE Intercolonial Medical Congress of Australasia announces its first meeting for February 3, 1896.

WITH the September number, the *American Journal of Psychology* enters upon its seventh volume. The preceding volumes (1887–1895) have been edited by President G. Stanley Hall (Clark University). For the future, the editorial responsibility of the *Journal* will be shared by President Hall, Professor E. C. Sanford (Clark University) and Professor E. B. Titchener (Cornell University). A coöperative board has been formed, which includes the names of Professor F. Angell, Professor H. Beaunis, Professor J. Delboeuf, Dr. A. Kirschmann, Professor O. Kuelpe, Dr. A. Waller, F. R. S., and Professor H. K. Wolfe. The *Journal* will be devoted exclusively to the interests of experimental psychology (psychophysiology, psychophysics, physiological psychology, etc.). Each number will contain, as heretofore, original articles, reviews and abstracts of current psychological books and monographs, and notes upon topics of immediate psychological importance. Contributions may be addressed to any one of the three editors.

DR. THOMAS HENDERSON CHANDLER, dean of the Harvard Dental School, died on August 27th, at the age of 71 years.

A SPANISH translation of *Maize: A Botanical and Economic Study*, by J. W. Harshberger (No. II. of the monograph series issued by the botanical department of the University of Pennsylvania) has been made by Dr. Nicolas Leon, of Guadalupe, Hidalgo, Mexico.

D. APPLETON & Co's preliminary announcements for the autumn include the following publications: A new edition of the *Natural History of Selbourne*, by Gilbert White, in two volumes with an introduction by John Burroughs and illustrations by Clifton Johnson with the text and new letters of the Buckland edition, a translation of Dr. William Hirsch's *Genie und Entartung*, *Psychology of Number* by Dr. J. A. McClellan and Professor John Dewy, *The Story of The Earth* by H. G. Seeley, and a new and revised edition of *The Sun* by Professor C. A. Young.

EIGHTY-TWO physicians from the United States and Canada were present at the British Medical Association. The Association will probably meet in Eastbourne, England, next year.

STATISTICS have been collected by order of the German government to study the effects of the serum treatment of diptheria. These statistics cover the first three months of 1895, and they are supplied by 232 physicians practicing in 191 hospitals. The percentage of deaths in 2,228 cases was found to be only 17.3.

THE general meeting of the *Social Science Association* is being held at Saratoga during the present week. The opening address by Dr. F. J. Kingsbury is on 'The Tendency of Men to Live in Cities.' The Association meets in the departments of Education, Health, Jurisprudence and Finance, each department having a different day set aside for the presentation of papers.

The Critic mentions a report that a posthumous volume of Huxley's essays will be brought out soon. It will contain most of his later writings, including a notable article finished just before his death. *The Life and Letters of Thomas H. Huxley*, edited by his son, is announced.

HENRY HOLT & Co. announce for publication in the autumn an introduction to the geological history of organisms entitled *Geological Biology* by Prof. Henry S. Williams; a laboratory companion to Remsen's 'Introduction to the Study of Chemistry,' entitled *Remsen and Randall's Chemical Experiments*, by Prof. Ira Remsen and Dr. Wyatt W. Randall; *Grasses of North America*, by Prof. W. J. Beal; a new and much enlarged edition of Prof. W. T. Sedgwick and Prof. E. B. Wilson's *General Biology*, and translations of Kerner and Oliver's *Natural History of Plants* (2d Vol.), and of Hertwig's *General Principles of Zoölogy*.

UNIVERSITY AND EDUCATIONAL NEWS.

PROFESSOR MARK W. HARRINGTON has accepted the presidency of the University of Washington.

GEN. J. WATTS DE PEYSTER has provided for the erection of a college of languages for the American University of Washington. The building will bear his name and a bronze statue of the donor will be erected in front of the college.

WE have received the new prospectus oı elective studies of Michigan Mining School. It states that the Board of Control and Faculty of the School have unanimously decided to adopt an elective system in the institution for the future, and the prospectus is issued to explain such variations in the course of instruction as will be introduced by this change. The elective system will go into full effect on September 16, 1895.

As stated in our issue of August 9th means of attracting foreign students to the University at Paris are being considered by a Committee specially appointed for the purpose. With this object in view, according to *The Nation* the University confers this year 'diplomas d'études Supérieures d'histoire et de geographie,' which may be obtained by all students including those who have not yet taken the B. A. degree. Students at the University can thus obtain official recognition of their work after having resided at the University for a comparatively short time.

THE announcement of the department of geology and paleontology of Union University for the ensuing year is received. In the advanced work particular attention is given to the paleontology and field geology of New York. During the spring term the last two days of each week were spent in field work, and typical exposures of all the formations ranging from the Potsdam of the Cambrian up to the Catskill of the Devonian were studied. This summer Prof. Prosser is studying the distribution and classifica-

tion of the Upper Devonian in central and eastern New York for the State Survey.

FIVE graduates of Michigan State Agricultural College, who were assistants or instructors, have recently been elected to other positions, as follows: F. B. Mumford, professor of agriculture, State University, Columbia, Mo.; A. T. Stevens, professor of agriculture at Green borough, N. C.; W. L. Rossman, chemist to State Pure-food Commision, Lansing, Mich.; U. P. Hedrick, professor of botany and horticulture, Corvalis, Oregon; A. B. Cordly, professor of entomology, Corvalis, Oregon.

IT is stated that Dr. Wilhelm Roux, of Innsbruck, has been called to the chair of anatomy in the University of Halle; Dr. K. Seubert, of Tübingen, to the chair of chemistry in the Technical High School, at Hannover, and Dr. Kallius, of Göttingen, to the chair of anatomy at Tübingen.

D. C. HEATH & Co. have in preparation 'The Connection of Thought and Memory: a Contribution to Pedagogical Psychology,' by H. P. Lukens, Ph. D., with an introduction by Dr. G. Stanley Hall. The work is based on F. W. Dorpfeld's 'Denken und Gedáchtniss.'

ACCORDING to the London *Times* the French have unearthed at Delphi the building that Pausanias describes as the 'Treasury of the Athenians;' and here they have discovered the remains of two large slabs of stone inscribed with words and music. In their first season's work they found 14 fragments of various sizes, of which they published an account last year. Four of these fragments were distinguished from the other ten by a difference in the notation of the music; and these four made up the piece that was introduced to the public as 'The Hymn to Apollo.' Fortunately, in their second season's work, the French have found another large fragment, to which the remaining ten can be adjusted with tolerable certainty; and now we have a second hynm. The decipherment has been intrusted, as before, to MM. Henri Weil and Théodore Reinach, and their version is about to be published in the *Bulletin de Correspondance Hellénique*. The duration of the musical notes is indicated by the syllables that were sung with them. Thus, for example, where three notes are attached to a word of one long syllable followed by two short syllables they must answer roughly to a crotchet followed by two quavers. The pitch of the notes is indicated by various letters of the alphabet. In the first hymn the letters were those that the Greeks prescribed for use with voices; but in this seconnd hymn they are those that were prescribed for use with instruments. As the Delphians would hardly have written down the accompaniment and omitted the song itself, we must suppose that the instruments and voices were here in unison.

ROBERTS BROTHERS will publish in the autumn a work on the history and topography of Constantinople by Professor E. A. Grosvenor, of Amherst College.

THE *Tribune* states that *The American Museum of Natural History* has received twenty skeletons exhumed by Mr. H. I. Smith in Mason County, Ky. The skeletons are in bad condition, but the ornaments and implements, including bone fish-hooks, are said to be of special interest.

A HURRICANE station has been recently established in Yucatan, and observations will be cabled from Mérida to New Orleans. It is hoped that the coöperation of the Mexican Meteorological Bureau will be secured with a view to establishing stations at intervals along the borders of the Gulf.

THE *Scientific American* states that Dr. Cornelius Herz has invented an improvement in telegraphy, by which more than 1,000 words can be transmitted by long

submarine cables in the same time that 20 words can be sent now. Dr. Herz's invention would allow of cabling 50 words at a cost of five cents, and would render submarine telephony and multiplex telephony feasible.

CORRESPONDENCE.

THE NATURE OF VOWELS.

THERE is one statement in Professor Le Conte's letter in SCIENCE (Aug. 16th) which seems to me worth further examination. He writes, "Now it is true that the vowels are true musical tones, but it is not true that each has its own pitch."

In a paper on the voice published in the *Journal of Physiology*, Vol. IV., 1883, I took ground on this subject at variance with the view set forth by Professor Le Conte at least in its most rigid form. I consider his statement a partial truth only.

My paper is not at hand, so I cannot quote from it, but the matter was put somewhat thus: There is but one position of the vocal apparatus —vocal bands and supraglottic parts—one structural and functional combination so far as the human vocal mechanism is concerned for the perfect production of each vowel, and the further this is departed from the greater the deviation from this true and perfect result. It will be noticed that the entire range in pitch in ordinary conversation is very limited, and even in the most exciting dramatic passages the range covers but a few notes. Moreover, the best classic music and the popular songs that are most lasting and effective have a limited range, all of which is a matter of considerable significance, but part of that significance is owing to the fact that the proper production of the vowels in their purity is determined as I have indicated; and the poet, orator, actor, singer or composer who recognizes this principle will prove so far as this can go most successful. Compare such words as 'roar' and 'scream.' What effect would 'roar' produce if spoken or sung at a very high pitch or 'scream' at a very low pitch?

Now, if any one doubts as to this let him make the simple test of singing the vowels o, u, a, at his highest pitch, and at the same time require some listener to name the vowel he is attempting to produce. I venture to say that there will be some very ludicrous answers, and I think the majority of persons will be convinced then that pitch does go a long way in the *proper* production of vowels. That something more or less like them may be produced at different points in the scale I do not question and, of course, we accept in practice these departures from the proper vocal effect or best result if not too great. WESLEY MILLS.

PHYSIOLOGICAL LABORATORY,
McGILL UNIVERSITY, MONTREAL.

THE 'DATE OF PUBLICATION' IN THE LIGHT OF THE LAW OF PRIORITY.

THE American Association for the Advancement of Science, in common with its sister organizations in Europe and in Australasia, has repeatedly had occasion to consider the question of scientific nomenclature; and as a result of many deliberations, zoölogists have practically agreed upon a code of rules, which have now been adopted by the International Congress and should be followed by every worker. These rules, as well as their predecessors, contain the so-called law of priority; and in consequence, the entire structure is made to depend on last analysis upon the 'Date of Publication.' How important it is then to define exactly what is meant by this term!

The present rules, adopted by the International Congress through the initiative of Dr. Raph. Blanchard, show a distinct advance in that they declare that the date at which a paper is read before a learned society does not constitute publication in the sense of this law. A thing to be published must be printed. Some still maintain that a memoir is published as soon as it leaves the hands of the author after the last corrections have been made upon it. I am even told that this is the ruling in certain legal cases—patents and the like. It is, however, a date which is in practice impossible to establish, and is consequently wholly unfitted for such a code of rules. These rules are confessedly arbitrary to a certain extent, and it is by no means necessary that we should avoid setting up a somewhat artificial rule in this case as well.

Such a step was taken by Dr. Blanchard in his first report, when he declared that publication in a daily newspaper could not be regarded as publication in this special sense, *e. g.*, the *Rostocker Zeitung*, though official organ of the *Rostocker Verein*.

Similarly it has been proposed that the date, of publication' should mean the date at which the printed work issues from press. This is an arbitrary ruling, and yet I fear it is not one which meets the needs of zoölogists. Let us suppose the case that a printed memoir lies for months in the desk of the author, unknown to any of his colleagues. Is it wise for us to accept a rule which shall give this withheld memoir priority over one which, though it was printed later, had already been long known to specialists? Such a course would result in a needless revision of established names and could surely raise no claim to being convenient.

But the third possibility is the one which has already won the support of the majority of zoölogists, and should, in my opinion, be incorporated into our rules. The difficulty, however, would be only half solved; we should know what the criteria are, but we should be at a loss to apply them, for the *date* of *distribution* can almost never be accurately determined. The date which the publisher uses is, as everyone knows, utterly untrustworthy. One does not need to have been specially occupied with bibliographical matters to know that the dates on the title pages of our scientific monthlies do not correspond with the time of issue; but that the 'June' number appears in May, etc. I have collected a large number of instances among journals upon whose dates we are more accustomed to rely, in which it was shown by internal evidence that the preface was written after the 'date of issue,' etc. I shall not publish this list, for it is something which everyone must have met in his own experience, and I do not wish to single out certain journals for criticism.

There seem to be but two ways to remedy this evil: either a reform must be worked in our methods of publication, or a date must be affixed by some competent agency. The former course is not likely to find favor, I fancy, with persons who have had experience in such matters. The second means seems to involve undue complication. Surely it is not necessary to maintain a recording agency for the single purpose of settling trifling disputes of priority. The case becomes, however, singularly simplified when we consider that the new bibliographical Bureau for Zoölogy* can readily undertake this task without materially increasing its labor. Indeed, it could do this simply in consideration of the greater promptness with which it would receive the publications for its index. In view of this circumstance, it seems desirable to make the following suggestion in regard to the date of publication:

The Bibliographical Bureau should record with each paper a date of approximate distribution, to be determined by the date at which the paper was sent to the Bureau. For this determination, the Bureau might (1) use the postmark; (2) deduct from the date of receipt the number of days ordinarily required for the transmission by post from the place of publication to the Bureau (this in case the postmark should prove illegible), or (3) record the date at which the the paper might have been mailed as a registered package. The ideal solution of the question would seem to be, since we have already the precedent of arbitrary rules adopted for convenience, to declare that not merely must a description be printed, it must also be placed on record. I would not be understood as advocating the incorporation of such a modification into our law priority. The practice would have to become quite general for such a step to be possible. I am, however, of opinion that it would be very desirable for the A. A. A. S. to take the necessary steps towards introducing this custom. HERBERT HAVILAND FIELD.

ELECTRIC STORM ON MOUNT ELBERT, COLORADO.†

THE daily course of the weather was very peculiar and singularly uniform. The mornings

* The new bibliological bureau is described in SCIENCE, N. S., II. p. 234.

† A storm experienced by Mr. Welker while occupying a triangulation station of the Coast and Geodetic Survey on Mt. Elbert, Colorado, in July, 1894. Mt. Elbert is about 14,440 ft. elevation. The camp was only one hundred yards from the summit.

H. G. O.

invariably dawned clear and beautiful. Details in distant valleys and on the horizon a hundred miles away were clearly discernible. Not a cloud could be seen above or below. About eight o'clock in the morning a faint mist would begin to make its appearance at numerous places far below the station. This would slowly ascend until at last every object below was completely lost to view. By noon the mist, now become a dense cloud, would reach the camp. It would then be difficult to distinguish objects only a few yards distant. Then the electric performance began. A loud buzzing sound pervaded the atmosphere. Everything was heavily charged with electricity. From every projecting point, from the tops of tent poles, from sharp pointed rocks, balls of electric fire shed an uncanny light. These lights varied in size from that of a small incandescent lamp to globes four inches in diameter. We could draw electric sparks from pieces of metal, from the walls of the tents and from each other's bodies. Our hair would stand on end and men's whiskers would frequently be aglow. At one time a ring of electric light encircled the rim of my hat like the pictured halos of the old masters. Every one on the summit would experience a tingling, pricking sensation and occasionally quite a violent shock. These feelings were very often decidedly uncomfortable, but they could be prevented by lying flat upon the ground. Animals upon the summit frequently became so restless from their electrified condition that it was necessary to let them go down the mountain.

These phenomena would continue for about one hour. The nature of the manifestations would then suddenly change and frequent discharges would occur. At once it would seem that the concentrated fire of all the artillery of heaven was poured upon Mt. Elbert. Lightning, thunder, hail and snow followed with such fury that it often seemed that the station must be abandoned to save the lives of the party. The flashes of lightning were almost continuous and peal after peal of thunder crashed around us like the roar of a ceaseless bombardment of which we were the unwilling targets. These fearful storms would invariably continue until nine o'clock at night. The phenomena of balls of light, hair standing on end, etc., etc., ceased at once when lightning and thunder began. Such phenomena were to be seen only when a cloud passed over the mountain's peak without producing lightning.

Although the party escaped surprisingly well, considering the violence of the assaults, considerable damage was done by the lightning. The observatory and theodolite were struck twice, the verticle circle twice, the azimuth mark once, and a rock cairn near the summit once.

The first damage done was on July 12th, at eight o'clock in the evening, during a furious hail storm. Simultaneous with a vivid and dazzling flash of lightning there came a crash of thunder that shook the mountain top itself and drove terror to every heart.

For a short time after this tremendous discharge not a sound was heard from any one. All were certain that lightning had struck the camp, but where was the damage done? The storm was still raging furiously and an examination was impossible at the time. Word passed from tent to tent assured us that all members of the party had escaped.

As usual, the following morning was clear and bright, and our steps were at once turned to the observatory and the damage done by the lightning the night before quickly ascertained. A small round hole about the size of a pea was burned through the canvas roof of the observatory. The lightning had struck the theodolite on the end of the sunshade or dew-cap and had melted a semicircular notch in its edge. Drops of molten metal had spattered over the objective and small bullet-shaped fragments of aluminum were scattered around. The anterior lens of the objective was badly cracked, probably from the heat of the molten metal, as the remainder of the objective was uninjured. The brick pier which supported the iron stand of the instrument had been partially torn to pieces and a good sized hole had been burnt in the floor. An examination of the theodolite showed that the pivots, the wyes and the foot screws were all badly burnt. The damage was repaired as well as the means at hand would permit, the rough places on the bearing surfaces being smooted with an oil stone.

Having thus put the instrument into fair working order, observations were resumed.

We had some little faith in the truth of the old saying that lightning never strikes twice in the same place, and as all signs of the storm had disappeared we now felt reasonably secure.

By noon, however, the weather again changed and we experienced almost an exact reproduction of the events of the day before.

This time the bolt of lightning struck earlier in the evening and caused somewhat greater damage. A small round hole was pierced through one of the two-inch rafters of the observatory roof. The theodolite was again struck, a second notch being melted in the rim of the sunshade. The molten metal was again spattered over the objective, and the pivots, the wyes and all bearing surfaces where two different pieces of metal came in contact were burned as before. This time the brick pier was completely shattered and an eight-inch furrow was ploughed through the rocky surface of the summit for about fifteen yards, when it disappeared beneath a snow bank. A little later upon the same evening a bolt struck the verticle circle, but did comparatively little damage to that instrument. A hole was burnt in the tent, the ridge pole was somewhat splintered, the wooden stand which supported the instrument was badly shattered, and a small furrow was ploughed through the ground. A small blister upon the circle showed the effect of the passage of the electric.

In my former experience I have found that all electric phenomena were more marked and the shocks more violent on sharp, isolated peaks. For some reason, Mount Elbert seems to be an exception, and I have come to the conclusion that there must have been something powerfully attractive in the rock composing the peak, perhaps a bed of magnetic ore.

P. A. WELKER.

SCIENTIFIC LITERATURE.

The Principles of Physics. By ALFRED P. GAGE, Ph. D. Boston, Ginn & Co. 1895. Pp. 634, with 493 illustrations.

Thirteen years ago the author of this textbook, after many previous years of practical experience as a teacher in high school work, put forth a manual for high schools, the guiding principle of which was expressed in the words, 'Read Nature in the Language of Experiment.' He advocated the plan of putting the pupil from the outset in the position of an inductive inquirer, of placing in his hands the simplest apparatus that could be made available, and of causing the experiment, whenever possible, to precede the formulation of the truth to be apprehended.

There were already many others who believed in the extension of the objective method of instruction to all subjects in which it could be made applicable, but Dr. Gage's position was so radical as naturally to cause much healthy discussion in relation to the practical limits of the inductive method in schools. The opinion is now very generally held that, in the teaching of physics, laboratory practice should either accompany or closely follow the study of principles; but it can scarcely be said that there are very many successful teachers who now advocate the plan of trying to make original discoverers of all the students who are required to become acquainted with the elements of physics within the limited time usually alloted in a high school or college programme. The brighter pupils may indeed be so directed as to be led to the rediscovery of some long-known truths; but these are also the ones whose eagerness causes them to devour with avidity all the information they can glean from books. The prescribed experiment is performed and the corresponding deduction is correctly expressed; but the knowledge had been acquired beforehand, so that the experiment merely confirms what had already been apprehended, instead of opening out a new avenue to knowledge. Pupils whose ability is only medium, or less than average, may follow the instructions given, but are seldom able to formulate the corresponding law except under guidance. Original discovery is for them out of the question. No law of nature has ever been discovered, even by a mature investigator, as the outcome of a single experiment; and the most successful investigators are keenly alive to the difficulty of so isolating the conditions of experiment as to exclude what is confusing or misleading. No one is ready to make a discovery in physics without considerable preliminary knowledge of principles.

In the present volume Dr. Gage avoids insist-

ence upon the doctrine to which he gave such emphatic expression in its predecessor. He states that it is simply a text-book, not a laboratory manual, but that its teachings should be supplemented by laboratory work and that "experiments are introduced chiefly for the purpose of illustrating principles and laws." With this clear statement of the object in view, he writes, not a revision of the older volume, but an independent expression of his riper experience in adapting the expression of truth to the capacity of those for whom the book is intended. These are in the main high school pupils, but a considerable amount of interesting material is introduced that is confessedly beyond the range of most of these pupils. The book is intended to include two courses, one for the high school and the other an advanced course suited for 'the requirements of the so-called classical courses in many colleges.' In such courses it is customary to avoid mathematical difficulties as far as possible; but it is safe to say that in many of them, certainly in our leading colleges, the course in general physics is so given as to include many applications of not only algebra and geometry, but also plane trigonometry and elementary analytical geometry. Indeed, the careful avoidance of equations, and the almost entire exclusion of trigonometry from the present volume, necessitates such fullness of verbal explanation as to amount to redundancy in some parts.

But, despite the objection just expressed, the explanations contained in this text-book are always clear, and the work has been admirably done. On every page are the marks of the skillful teacher, methodical, careful and accurate. To say that there are no mistakes would be, of course, inadmissible, but they are unusually few. The author has been alert in keeping up with the results of recent physical investigation, and many old definitions and technical terms have been so modified as to adapt them to modern demands. The book will undoubtedly be very useful, not only in the high school, but as a book for parallel reading by the college student, whose course in the class room is more mathematical, but who wants the 'plain English of it' where difficulties are encountered. To such it can be heartily commended, although he will perhaps find less than he wants on some special topics, such as elasticity, moment of inertia, and the physical pendulum. The presentation of the elementary principles underlying the dynamo, the motor, the transformer, and other familiar applications of electricity will be found particularly good.

A few words of adverse criticism may perhaps be applied to some points that are capable of easy modification and relatively of inferior importance.

The term 'centroid' is employed in many places where 'center of mass' is implied. The latter is explicit; the former is unnecessary. The two expressions are used about equally frequently. Centroid has not come into general use, whatever may be the objection to such generally used expressions as 'center of mass,' 'center of inertia,' or 'center of gravity.'

In saying (p. 223) that 'if two tones form a narrower interval than a minor third, the combined sound is harsh and grating on the ear,' the author forgets that this is not true for the higher parts of the musical scale. These facts were fully investigated by Mayer about twenty years ago.

The specific heat of water (p. 263) is represented to increase continually from 0° to 80° C. The figures given are those of Regnault (1850). More recent careful investigation by Rowland and others has shown that the specific heat of water decreases slightly from 0° to about 30° and then increases gradually to 100° C.

Absolute zero (p. 273) is said to be 'a point of absolute cold or absence of heat, beyond which no cooling is conceivable.' This statement is admissible only on the assumption that the laws of Boyle and Gay Lussac are applicable rigidly at even the lowest temperatures, an assumption which is now known to be not admissible.

It is stated (p. 417) that 'carbon bisulphide is exceptionally transparent to all forms of radiation.' This may be qualified by adding 'except the violet and ultra-violet.'

There are a few other points, the noting of which would unduly extend this criticism. There are few text-books in which the first edition is so free from serious errors.

W. LE CONTE STEVENS.

Die Theorie der Parallellinien von Euklid bis auf Gauss, eine Urkundensammlung zur Vorgeschichte der nichteuklidischen Geometrie, in Gemeinschaft mit Friedrich Engel, herausgegeben von Paul Stäckel. Leipzig, Teubner. 1895. [July].

This book is a striking example of one of the many beneficent characteristics of our present civilization. Here all the works which show the gradual but sure development of the human mind toward an achievement of modern thought unsurpassed for interest and importance, books so rare that, so far as I know, not one is contained in any public library on the western continent, are put within the reach of the poorest student. Here we have, edited with the most painstaking accuracy, Wallis, Saccheri, Lambert, Schweikart, Taurinus, the forerunners of the non-Euclidean geometry.

The jump made by Bolyai and Lobachevski, the Magyar and the Russian, will no longer seem so bewilderingly long and unanticipated. How they, about the same time, 1829, came to publish each a complete, a full-fledged non-Euclidean geometry was a problem which provoked an unfortunate pseudo-solution, a hypothetical construction, which is still repeated, and even to be found in the pages of SCIENCE. [March 29, 1895, pp. 357–8.]

After a lecture on Saccheri at the World's Fair Science Congress, since published under the title 'The non-Euclidean Geometry Inevitable,' in the Monist, July, 1894, pp. 483–493, Professor Felix Klein, of Goettingen, who was present and said that never before had he so much as heard even the name of Saccheri, was asked why in his Nicht-Euklidische Geometrie, 1889–90, he says: "Kein Zweifel bestehen kann, dass Lobatscheffsky sowohl wie Bolyai die Fragestellung ihrer Untersuchungen der Gaussichen Anregung verdanken" [p. 175, Zweiter Abdruck, 1893]. He answered, that he believed he would be justified when Schering published the 'Nachlass von Gauss.' Such special personal information from Schering perhaps is referred to on the preceeding page, 174, in the sentence: "Dies sind die saemmtlichen Notizen, die man *in allgemeinen Kreisen* ueber die Gaussichen Untersuchungen, betreffend die nichteuklidische Geometrie besitzt."

This very question to Professor Klein, as to how he could justify his ungenerous statement, must have been again put to him by Engel and Stäckel, and he must have given essentially the same answer; for, after stating his opinion, they say of it, p. 243: "Eine Entscheidung ueber die Richtigkeit dieser Vermutungen wird kaum moeglich sein, solange der Nachlass von Gauss der Forschung unzugänglich ist."

But how little we can trust the unchecked judgment of Klein in this matter is strikingly shown by what he says of Gauss's letter to Bolyai of 1799, on this very page 174: "Dies ist das interessanteste hierher gehoerige Dokument, da es noch ganz aus Gauss' Jugendzeit stammt. In diesem letzteren Brief ist besonders gesagt, dass es in der hyperbolischen Geometrie ein Maximum des Dreieckinhaltes gebe."

This letter is given in full in the English translation of the Science Absolute of Space by Bolyai János, and again in the Monist, (p. 486), and is reproduced by Staeckel (p. 219). What it really says is about as far as could be well imagined from the statement of Professor Klein. If Schering can do no better than that, we need not wait to declare that there is not the slightest particle of evidence that either Bolyai or Lobachevski were even in the remotest degree influenced by Gauss.

A certain 'Gymnasiallehrer,' Richard Beez, mentioned slightingly by Professor Klein on p. 277 of Part I. of his Nicht-Euklidische Geometrie, as incapable of grasping the subject, yet presumed on p. 15 of a pamphlet published at Plauen to use the expression, 'Gauss, der Lehrer von Bolyai und Lobatschewsky.' This irritating misstatement was reproduced by Dr. Emory McClintock in the Bulletin of the New York Mathematical Society, and when written to about it he asked Beez his grounds, and of course found there were none. In his retraction, Bulletin, March, 1893, p. 146, he cites, as some justification, the paragraph from Professor Klein already discussed, and says: "In the paper already cited I followed Beez in stating too strongly the probable connection between Gauss and Lobatschewsky. I am indebted for my first knowledge of Beltrami's account of Saccheri to a letter from Professor Beez, in which he admits his mention of Gauss as the

teacher of Lobachewsky to be partly inferential, and not to be taken literally." It is to be taken, we suppose, in some 'Pickwickian' sense.

This letter of Beez incited Dr. McClintock to an examination of Beltrami's article and a paper on it under the title 'On the early history of the non-Euclidean geometry,' where among other mistakes he makes one peculiarly entertaining. He says, p. 145, Bulletin, Vol. II., of Saccheri: "He confessed to a distracting heretical tendency on his part in favor of the 'hypothesis anguli acuti,' a tendency against which, however, he kept up a perpetual struggle (diuturnum proelium). After yielding so far as to work out an accurate theory anticipating Lobatschewsky's doctrine of the parallel-angle, he appears to have conquered the internal enemy abruptly, since, to the surprise of his commentator, Beltrami, he proceeded to announce dogmatically that the specious 'hypothesis anguli acuti' is positively false." Who would suspect that all that is a pure fairy tale evolved by Dr. McClintock from his mistranslation of a passage immediately announced by the two Latin words he fortunately retained in parenthesis!

As some slight acknowledgment of the fine spirit in which the previous criticisms had been received, a transcript was made of a considerable portion of a copy of Saccheri then being translated into English, the only copy then on this continent, and sent to Dr. McClintock. After another examination and comparison of the article by Beltrami, Dr. McClintock wrote a frank acknowledgement of his mistake, but this time published no correction.

Mr. A. Ziwet, noticeable as a converted anti-non-Euclidean, repeats the older error in a review of the translation of Vasiliev's Address on Lobachevski:—"confirms the supposition that the first impulse to these studies came to him, at least indirectly, from Gauss. To the same source of inspiration must be traced the almost simultaneous, but independent, researches of the Hungarian Wolfgang Bolyai and his son Johann." [SCIENCE, March 29, 1895, p. 358.] It is rather a pity if it '*must*,' since it never can be. A life of Bolyai from original Magyar sources, which is now in press, puts a totally new aspect upon the whole matter, which need not here be anticipated. These Magyar documents make it possible to offer to Professor Staeckel a slight correction, which is given as homage to the extraordinary accuracy of his book. On p. 241 the title of the Tentamen includes the words 'Cum appendice triplici.' Then follows the statement, "In dem dritten Anhange, der nur 28 seiten umfasst, hat Johann Bolyai seine neue Geometrie entwickelt."

It was not a third appendix, nor is it referred to at all in the words 'cum appendice triplici.' These words, as explained in a prospectus issued by Bolyai Farkas asking for subscribers, referred to a real triple appendix, which appears, as it should, at the end of the book, Tomus Secundus, pp. 265–322.

The now world renowned Appendix by Bolyai János was an afterthought of the father, who prompted the son not 'to occupy himself with the theory of parallels,' as Staeckel says, but to translate from the Magyar into Latin his treatise discovered in 1823, given in writing to J. W. von Eckwehr in 1825. The father, without waiting for Vol. II., inserted this Latin translation, with separate paging, as an appendix to his Vol. I., where, counting a page for the title and a page 'Explicatio Signorum,' it has 26 numbered pages, followed by two unnumbered pages of Errata. The treatise itself, therefore, contains only 24 pages—the most extraordinary two dozen pages in the whole history of thought!

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

Chinook Texts. FRANZ BOAS. Washington, 1894. Pp.278.

The linguist who in publishing elementary treatises on the languages of primitive peoples was the first to subjoin national texts and to comment on these texts philologically, certainly found the correct method. But it is a pity that so few of his colleagues and co-workers have followed his example, for ten pages of well-edited texts of aboriginal, oral literature accomplish more for the deeper study of these forms of human speech than one hundred pages of vocabulary or of crude, undigested grammatic information. But recently the publishing of such texts has become quite the fashion. The late James O. Dorsey intended to publish a series of works on the Omaha and Ponka language, and

the first installment of this series being a ponderous quarto volume of Indian *texts* (myths, animal stories, legends and correspondence) with notes and translation, proves that Dorsey was inspired by the same thoughts.

The Chinook family of dialects is too little known even at the present time, but Boas has made an excellent beginning by filling one of J. W. Powells' *Bulletins of the Bureau of Ethnology*, octavo size, with 'Chinook Texts' gathered by himself. These were all obtained from a gifted man of the tribe, Charles Cultee, who is a true storehouse of aboriginal folk-lore and speaks also the Kathlamet dialect of this same stock. From him Boas obtained eighteen national myths and animal stories, followed by a series of 'beliefs, customs and tales,' with some historical reports. These texts were written down during the seasons 1890 and 1891 at Bay Center, Pacific county, Washington, not very far from the Old Chinook home at the mouth of Columbia River. By a sentiment of grateful remembrance the explorer had the portrait of Cultee placed at the head of the volume which contains 278 pages, and was issued late in 1894 from the Government Printing Office in Washington.

Dr. Boas' scientific alphabet had to be very special and flexible to express the sounds of Chinook, a tongue which people will hardly venture to call sonorous or euphonious, for it abounds in consonantal combinations, and more so at the end of the words than elsewhere. The word-accent is never placed upon the ultima, but always on the penult or ante-penult, and this is the law of the language which made consonantal clusters possible in the *final* syllables. The Shawnee, of the Algonkinian stock, has an opposite law; it has the tendency to emphasize words at the end or ultima, and hence we find vowel elisions and consonantal accumulations in the beginning of the words.

As for the contents of the Chinook stories in which fish, ravens and gulls, cranes, robins and panthers are anthromorphized extensively and much of the fictive matter is presented in colloquial form, we may state that some are outrageously queer and weird; others reveal a poetic vein beneath many things that seem odd and nonsensical, puerile and childish to us. What refers to the religion of these natives appears very strange, and many will be prompted to exclaim: "Why! for religion, this is decidedly ungodly!" Indeed, we cannot expect that our religious sentiments, which are half Aryan and half Semitic, could ever agree with those of the red man's tenets, beliefs and inspirations. But our religion is all abstraction and theirs is all nature, life and animism. The religious aspects of the primitive man tolerates nothing that is not based on forms and facts of concrete life. The present reviewer is firmly convinced that any white man's opinion concerning the tendencies pervading Chinook folklore and similar products of aboriginal peoples is premature and hence erroneous, unless all the bearings and characteristics of this literature have been assiduously studied. Many of us think it is easy to judge the genuine mental products of the American native from our points of view; on the contrary, it is extremely difficult, and the more we study these products, the more the difficulties increase.

A. S. G.

The Life and Traditions of the Red Man. JOSEPH NICOLAR. Bangor, Me., 1893. Pp. 147.

Joseph Nicolar is an Indian of the Penobscot tribe settled on islands in the Penobscot River, Maine, and counting about 400 people. These Indians are quite industrious and inventive; they construct birch bark canoes and manufacture basketry of very neat patterns, which they sell either at the neighboring town of Old Town, or at the watering places of the seaside of the New England coast. The Penobscot Indians adhere to the Roman Catholic faith, which was planted among them in the beginning of the eighteenth century. Mr. Nicolar has made it a life-task to study, publish and propagate the folklore of his own people and in 1893 published to this effect '*The Life and Traditions of the Red Man.*' It is an interesting collection of 147 pages, which for graphic qualities and fluency of style rivals any similar production of the white man. It describes the ancient customs and beliefs, not of the Indian in general, as the title would make us believe, but only of the Abnákis or New England Indians of Algonkin race and language, who are subdivided into Penobscots, Passamaquoddies, Micmacs and St. Francis Indians.

The main figure in these stories is *Gluskap*, their chief deity and lawgiver, who unites with his divine power and oratory the qualities of a clown, liar and deceiver. Several aboriginal religions have their main deities clothed in this same ragamuffin or Falstaff garb, and instances of these are Manabozho or Ninebush—the great Rabbit— of the Ojibwē, Sinti among the Kiowas and Kmukámtch among the Klamaths of Oregon. There is no doubt but that they are deifications of the sun and sky, of the winds and storms, and of the seasons of the year. The name of Gluskap is the usual Abnáki term for *liar* and *deceiver*, but it is rather difficult to discover his real appellation when Nicolar writes him 'Klos-kur-beh.' The book shows a remarkable effort on the part of an Indian to explain to the white man his peculiar manners and ways in life and religion, and the face of the author, of whom a good portrait is added as frontispiece, shows the earnestness of his purposes. The preface is dated Old Town, Maine, but the book was printed at Bangor.

A. S. G.

Vergleichende Pflanzenmorphologie. Von DR. E. DENNERT. Mit über 600 Einzelbildern in 506 Figuren. 254 Seiten. Verlagsbuch handlung von J. J. WEBER, Leipzig, 1894.

In giving a new science text-book to the world, an author ought to have something valuable to present, in order to fix the attention of the scientific public. Dr. Dennert has attempted to do this, and has succeeded in putting in a clear and forcible way the principles of vegetal morphology. Dr. Dennert in his comparative outline does not claim to have made any new departure, but he wishes to give the laity the fundamental tenets of morphological botany. He hopes that the book may prove a useful repertory to students who desire a compendium on the comparative macroscopic structure of plants.

The book puts in a concise and comprehensive form the essentials of vegetable morphology. Most of the figures are good and new, and give the tyro a fair pictorial representation of a variety of interesting plant structures. The arrangement is, as it should be, scientifically logical. Starting with the cell as the unit of plant life, he unfolds in a short chapter the principal points of vegetable histology. The sections on root, stem and leaf commend themselves for clearness and lucidity. Nothing more could be desired for beginners than the sketch of the leaf presented in Section III. of the book. After a brief summary of the development of leaf forms, he follows with a clear exposition of leaf morphology by treating the subject under the following categories.* Cotyledonary leaves (keim-blätter), scale leaves, especially on rhizomes (nieder-blätter), foliage leaves (laub-blätter) with stipules (neben-blätter), bractsc (hoch-blätter, deck-blätter) and floral leaves (blüten-blätter). By leaf arrangement, as distinguished from phyllotaxy or leaf situation, Dr. Dennert would mean the various adaptive positions of the leaf with respect to light, moisture, heat, as also leaf mosaics. The interesting features of metamorphosed leaves, leaf traps, leaf pitchers, leaf thorns and fleshy leaves receive due consideration, as also heterophylly as represented in *Ranunculus aquatalis* and *Platycerium Wallinkii.*

The development, or growth of the leaf from the primordial leaf (primordial blatt) and its parts, the embryological leaf base (blatt grund), and the embryological leaf blade (ober-blatt), presented in closing the discussion of leaves, helps to clear up any difficulty which the student may have as to the morphological conception of a leaf, especially as to the nature of stipules.

Dr. Dennert has attempted to give in one hundred pages (134–234) the morphology and 'biology' of the flower and fruit, and has, therefore, only succeeded in giving a mere outline of this topic of absorbing interest. One might wish that the author had enlarged upon the adaptive arrangements of flowers in relation to insect visitation, but Dr. Dennert doubtless left this subject, wisely, for exposition by the individual teacher.

The book, however, as a whole, is to be commended to those who desire to obtain in a short time a general knowledge of plant morphology.

JOHN W. HARSHBERGER.

UNIVERSITY OF PENNSYLVANIA.

* The German terms are given, because there seems to be considerable confusion among students, as to the exact English equivalents.

SCIENTIFIC JOURNALS.

BOTANICAL GAZETTE, AUGUST.*

Synopsis of the North American Amaranthaceæ, III.: EDWIN B. ULINE and WM. L. BRAY. An enumeration of the North American species of this order, with synonymy and remarks upon the recognized species and varieties, together with descriptions of new ones. The genera *Frœlichia*, *Gossypianthus*, *Guilleminia*, and *Cladothrix* are treated in this installment. *Frœlichia interrupta cordata*, *Gossypianthus lanuginosus Sheldoni* and *Guilleminia densa aggregata* are described as new.

Notes from my Herbarium, III.: WALTER DEANE. In this note Mr. Deane describes his methods of mounting plants. As his herbarium is remarkable for the beauty of the specimens his advice on these matters is especially valuable.

Some Euphorbiaceæ from Guatemala: JOHN P. LOTSY. The last representatives of this order from Guatemala acquired by Capt. John Donnell Smith are here enumerated by Dr. Lotsy. *Euphorbia rubrosperma*, *E. microappendiculata*, *E. leucocephala*, *E. chamæpeploides*, *Croton eluterioides*, *C. Guatemalensis and Tragia Guatemalensis* are described as new. On two double plates three of these new species are figured.

Vegetal dissemination in the genus Opuntia: J. W. TUOMEY. Professor Tuomey calls attention to the fact that the persistency with which these cactuses retain their moisture fits them for vegetal dissemination. The prostrate flat-jointed forms spread by rooting where they touch the ground and having the older parts die away, while the cylindrical erect forms have barbed spines by means of which their joints are transported. Few depend upon seed dissemination.

A study of some Anatomical Characters of North American Gramineæ: TH. HOLM. In this paper the author concludes the examination of the species of *Leersia* and enumerates the anatomical characters of the leaves by which they can be discriminated.

Daniel Cady Eaton: GEORGE E. DAVENPORT. This is a short but appreciative biographical sketch of the late Professor Eaton, by one who has long been associated with him in the critical study of the ferns. A portrait accompanies the sketch.

The Nomenclature Question: A Further Discussion of the Madison Rules: B. L. ROBINSON. Dr. Robinson replies to Mr. Coville's criticisms in the July number and again vigorously attacks the doctrine of 'the rejection of thehomonyms.'

Among *Briefer Articles* is one describing a new genus of Umbelliferæ from Mexico, which the authors, Dr. John M. Coulter and Mr. J. N. Rose, dedicate to Mr. Walter Deane under the name of *Deanea*, with two species, *D. nudicaulis* and *D. tuberosa;* and one by Dr. Trelease, asking for information in regard to the distribution of our species of pignuts. An *Editorial* vigorously defends the *Gazette* against the charge, by an anonymous correspondent of the Journal of Botany, of suppressing free discussion of the nomenclature question. Under *Current Literature* Mr. Charles Robertson reviews MacLeod's 'Fertilization of Flanders Flowers,' and the editors notice a new issue in Ostwald's 'Klassiker der exakten Wissenschaften.' Two pages of *Notes and News* conclude the number.

*Issued August 15, 1895. 40 pp., 5 pl.

PSYCHE, SEPTEMBER.

W. S. BLATCHLEY continues his account of the winter insects of Vigo county, Ind., adding 26 more species of Hepteroptera. G. B. King finds from repeated observations of frozen nests that *Formica obscuripes* does not retreat into the lower parts of the nest in winter, but remains practically in all parts excepting close to the surface, though, of course, wholly inactive; some of the parasites are noticed. In a supplement, T. D. A. Cockerell describes a couple of new bees and some new Coccidæ and adds a note on a Mutillid which 'as it runs over the ground . . . looks extremely like a bit of thistle down blown by a gentle breeze.'

NEW BOOKS.

Tables for the Determination of Common Minerals. W. O. CROSBY. Third edition rewritten and enlarged. Boston, The Author. 1895. Pp. 106.

Fishes, Living and Fossil. Bashford Dean. Columbia University Biological Series III. New York, Macmillian & Co. 1895. Pp. xiv+300.